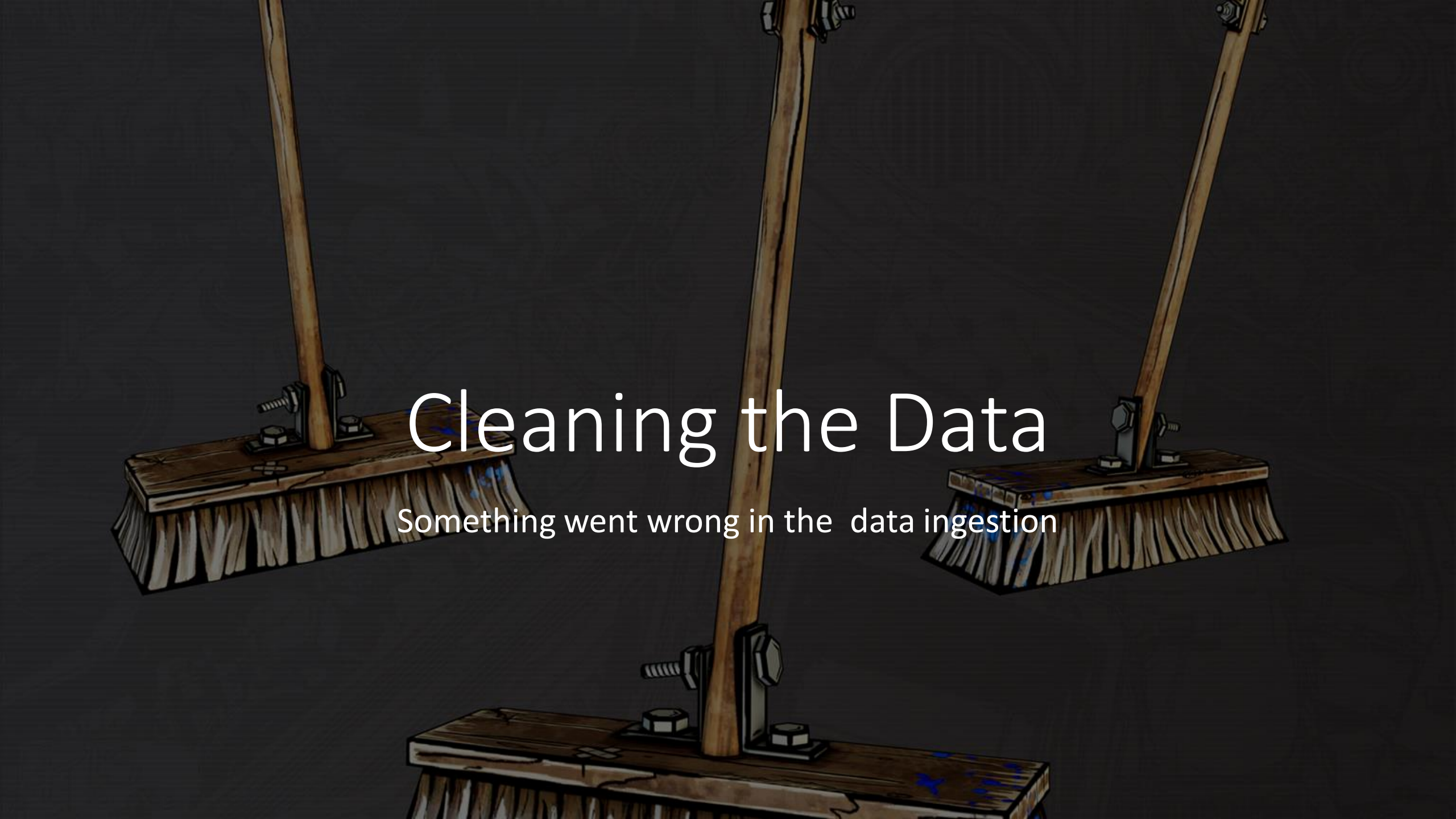
Cleaning the Data and Analyzing It

Alvaro Hu



Cleaning the Data

Something went wrong in the data ingestion

Received two files

CSV file

- Contains player usage metrics
- Many corrupted rows (500,000 out of 1,700,000)
  - Cleaned in Python and Excel resulting table ~1,500,000 rows

JSON file

- Contains 5 hours of player metrics
- Split into two tables, 1 for each JSON endpoint

* Data Cleaning steps in Appendix

The Final Data Tables

full_data -> from CSV

Contains each player session, character they used, map, playtime, etc. Essentially usage data

1.7 million rows

Added columns: SESSION_TIME, DAY_NUM

- Will help in analysis

sessions -> from JSON

More usage metrics, but these can be joined to the “weapons” table.

Subset of 5 hours of data

~100,000 rows

Added “date” column from Timestamp

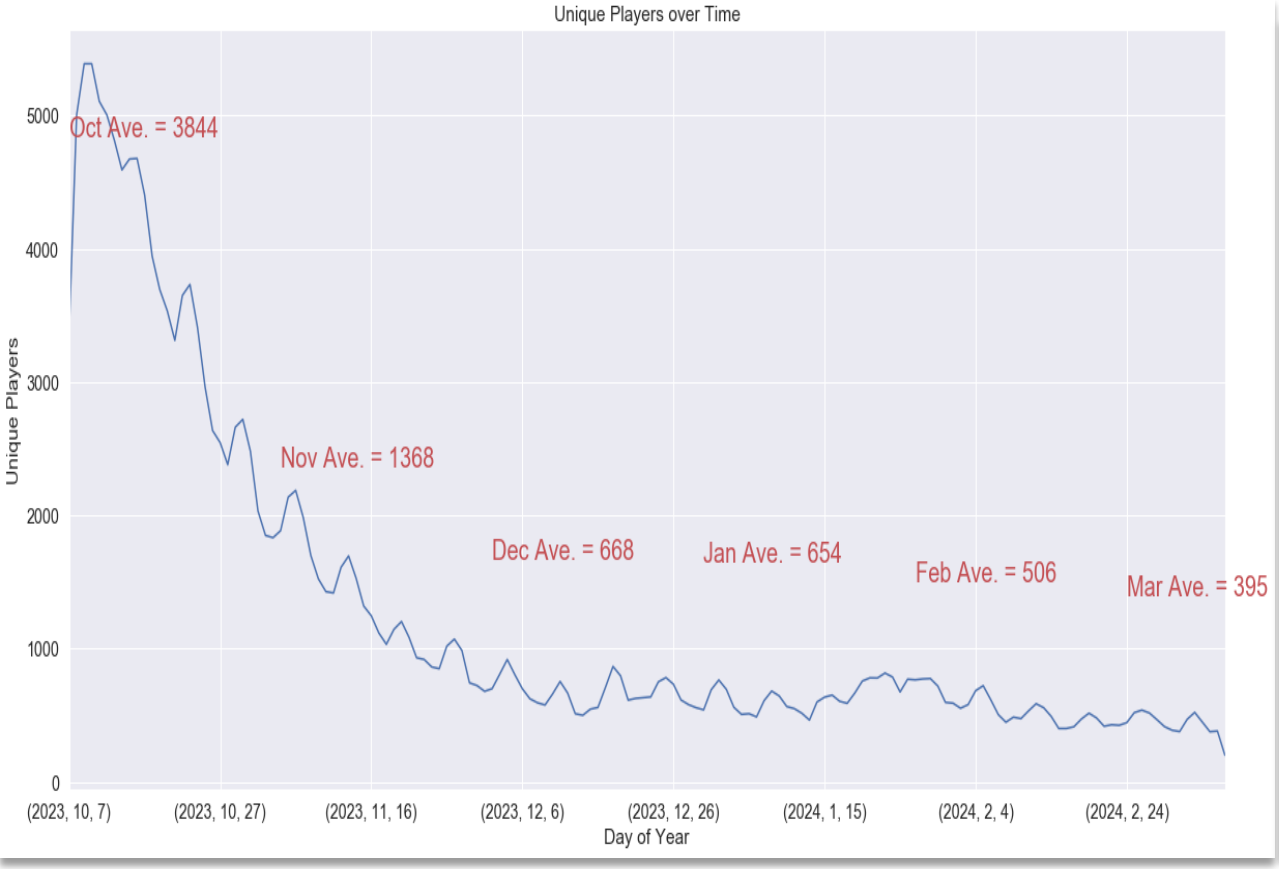
weapons -> from JSON

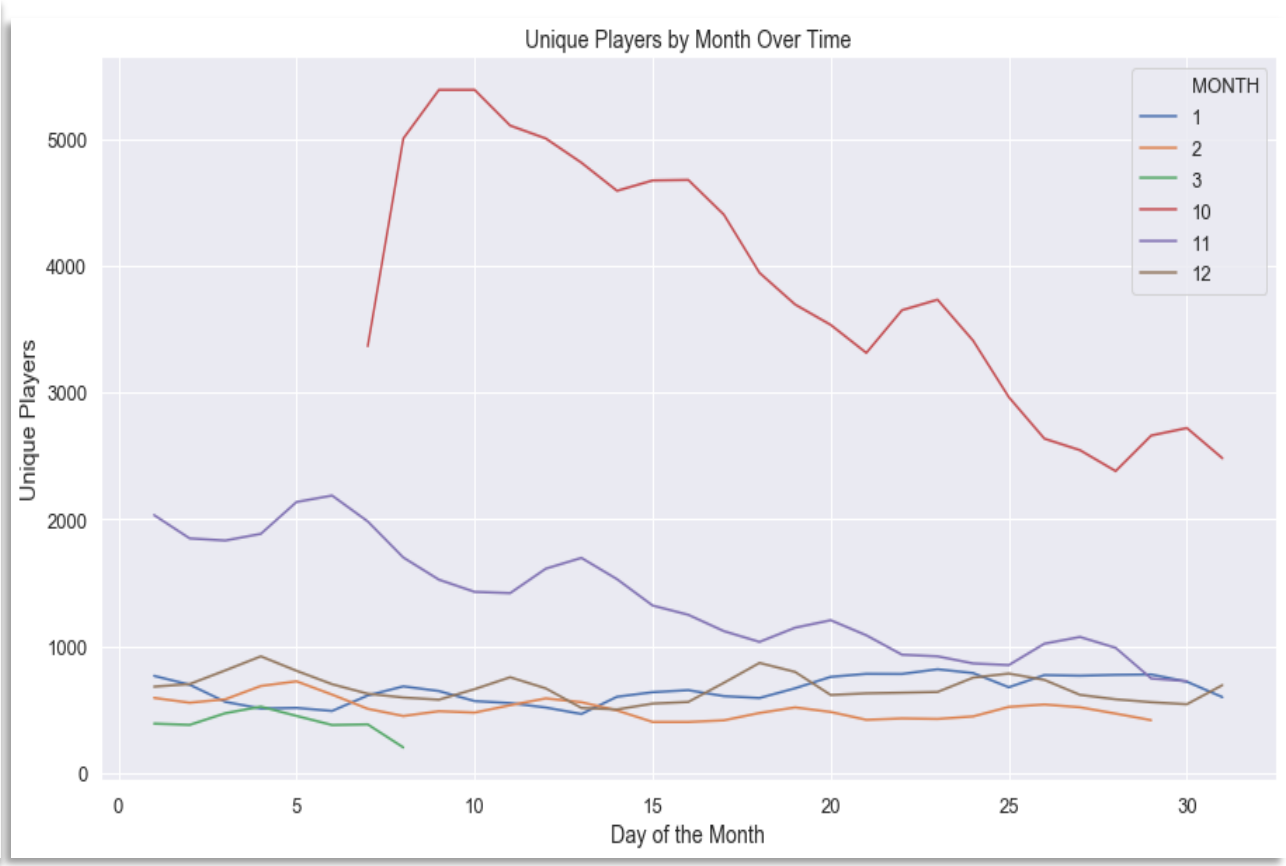
Contains the character, type of weapon, amount and types of damage, etc.

~700,000 rows

Joins to “context” table in one-to-many relationship

Exploring the Data



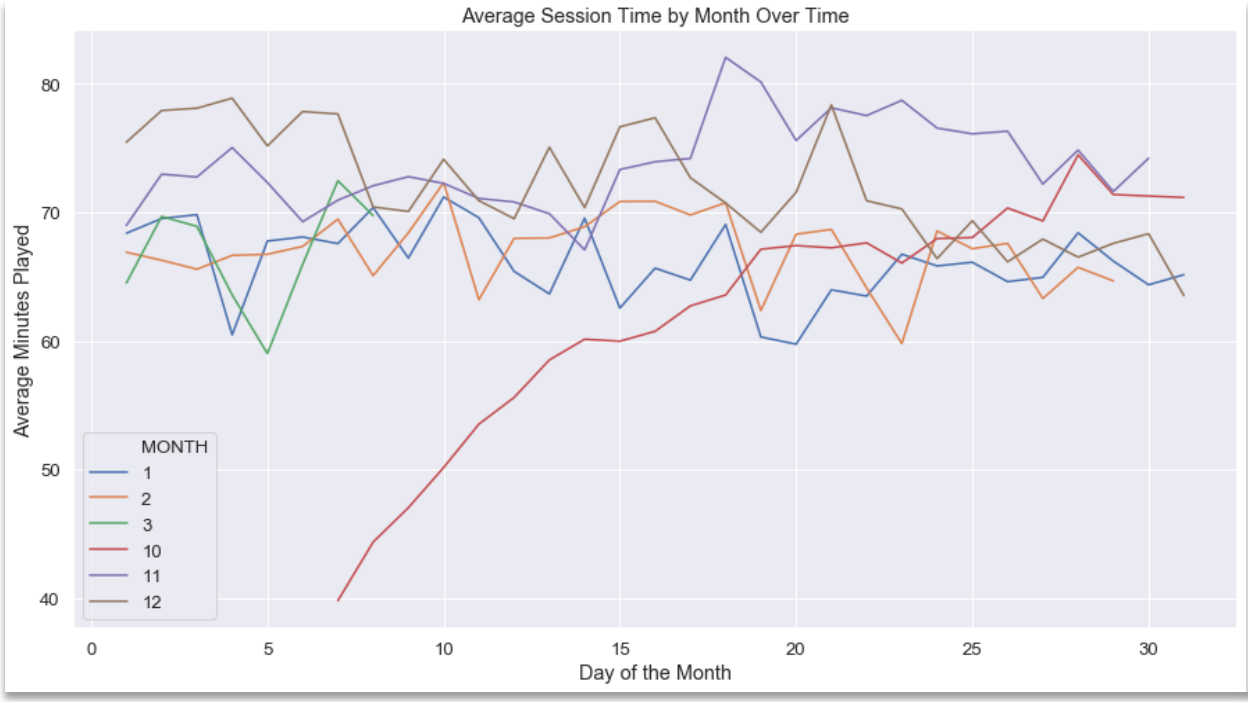


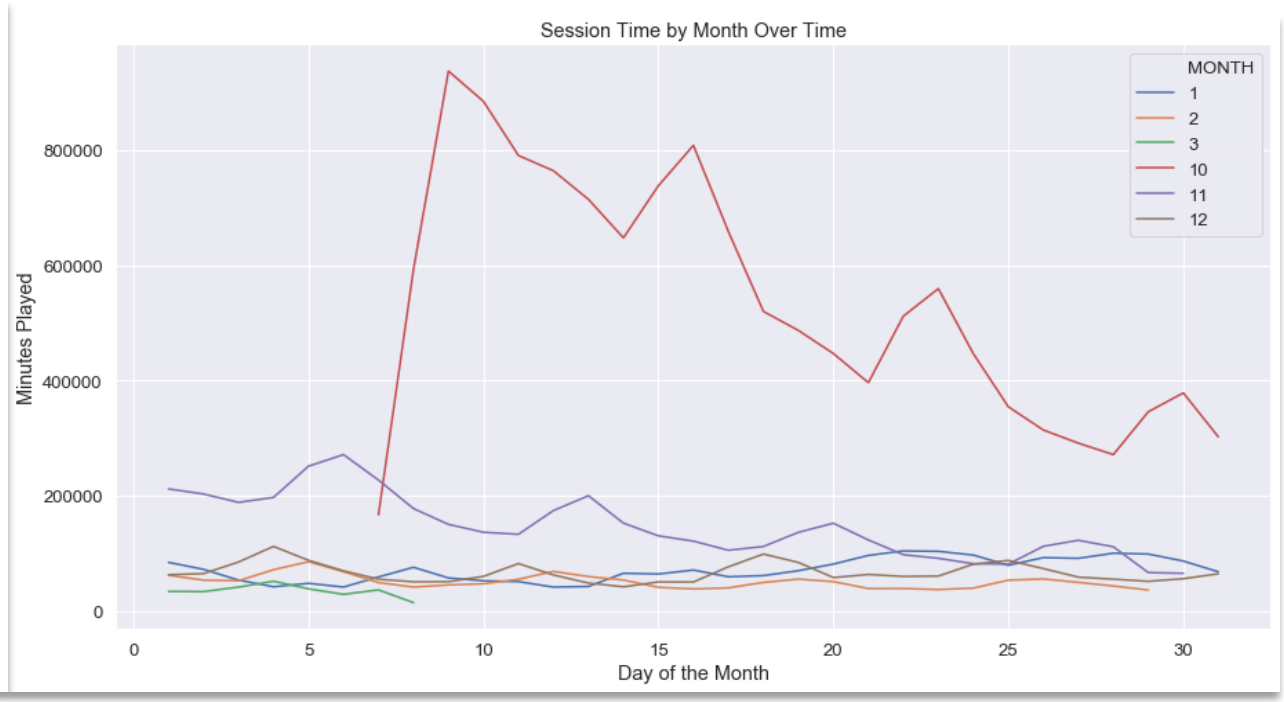
Unique Players per Month

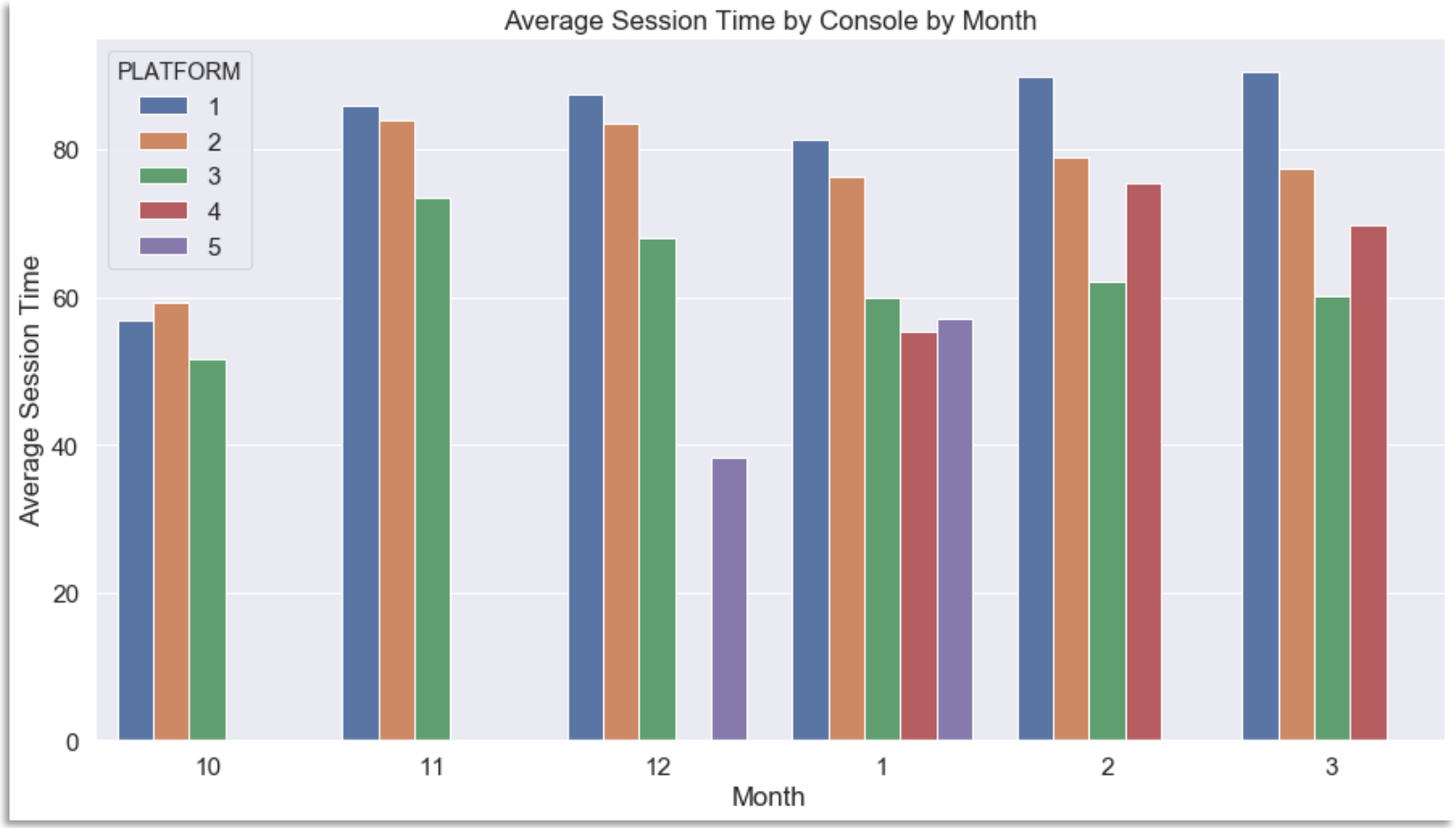
* Analyses in written form in Appendix

The number of Total minutes played per day also increases on the weekends

People’s session times remain more-or-less constant over the months.

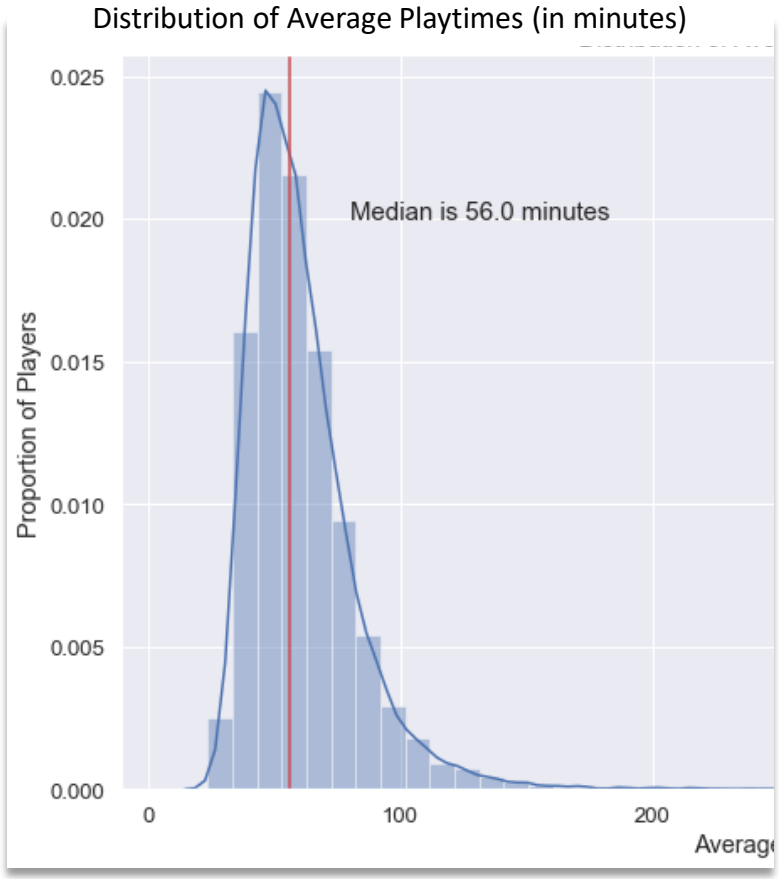


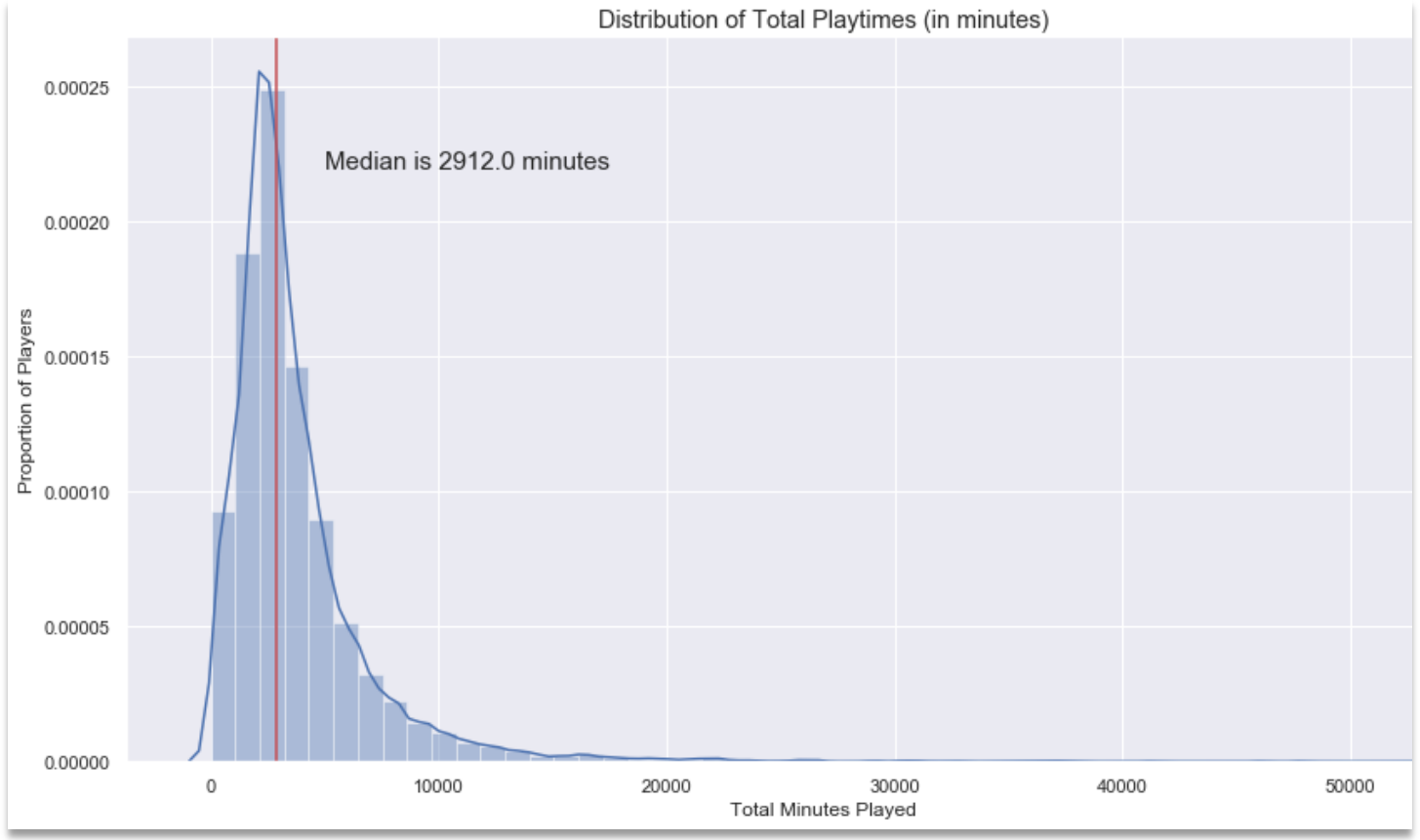




Number of Players	
MONTH	
1	3110
2	2264
3	897
10	8058
11	5423
12	3211

People played it for shorter amount of time in October, but there were more players





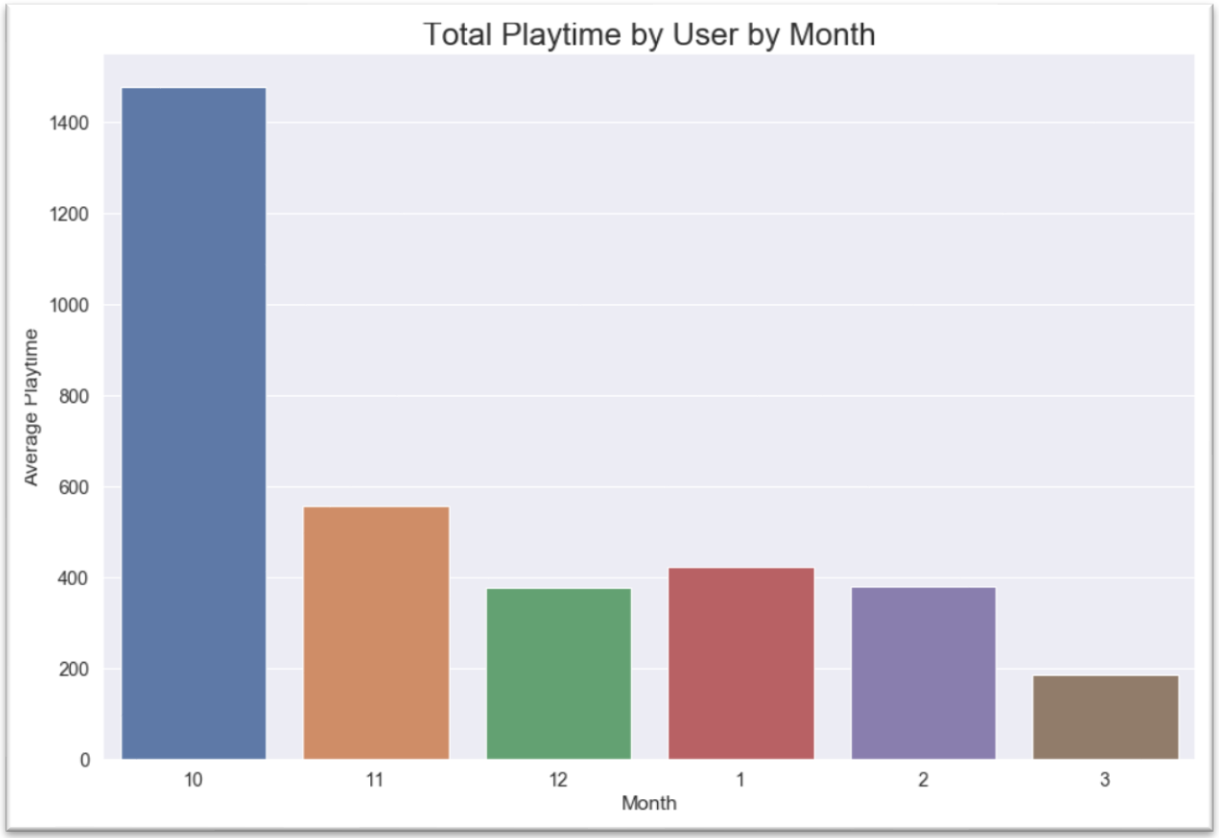
How long are people playing?

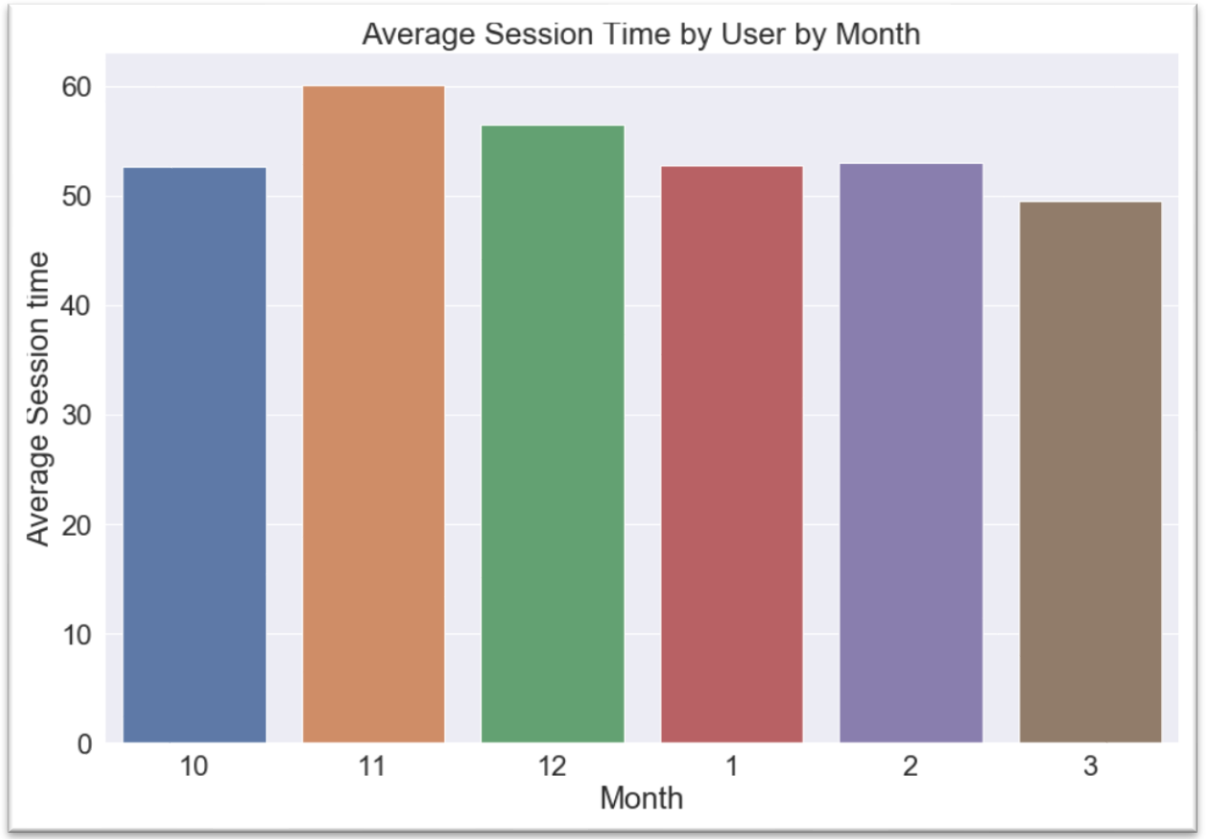
- Does it have the “Just one more” component?

* Additional analyses in written form in Appendix

Playtime By Month

- Winter break/vacation affecting player behavior?

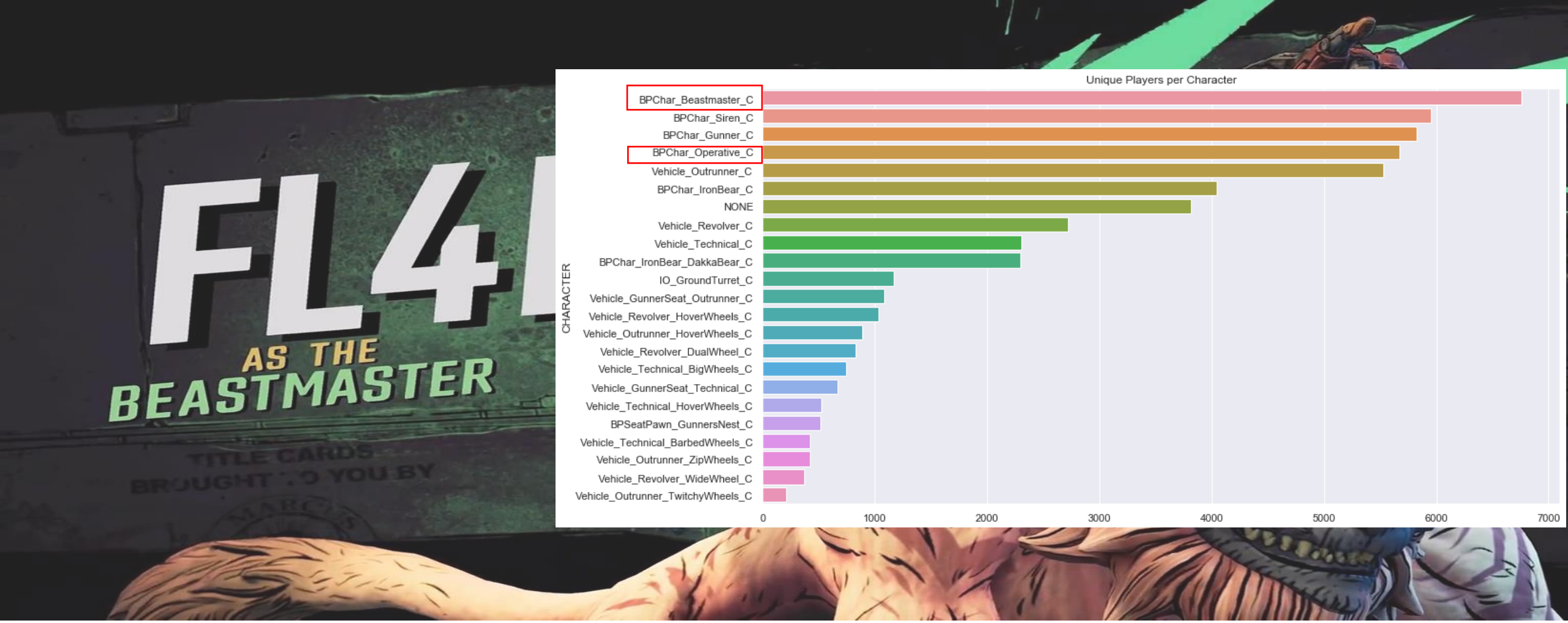




* Additional analyses in written form in Appendix

Summary on Playtimes

- October (release month) had the most unique players by far
  - Player count peaks on weekends.
- Though less players now, still play for the same time (~1 hour)
  - For some reason, average playtime was low in October
    - Possible reasons:
  - People played more on average in November and December. Thanksgiving and Holiday vacation?
- Total amount of time people play is ~3,000 minutes or about 50 hours of gameplay
  - This makes sense, as Borderlands is an open-world RPG

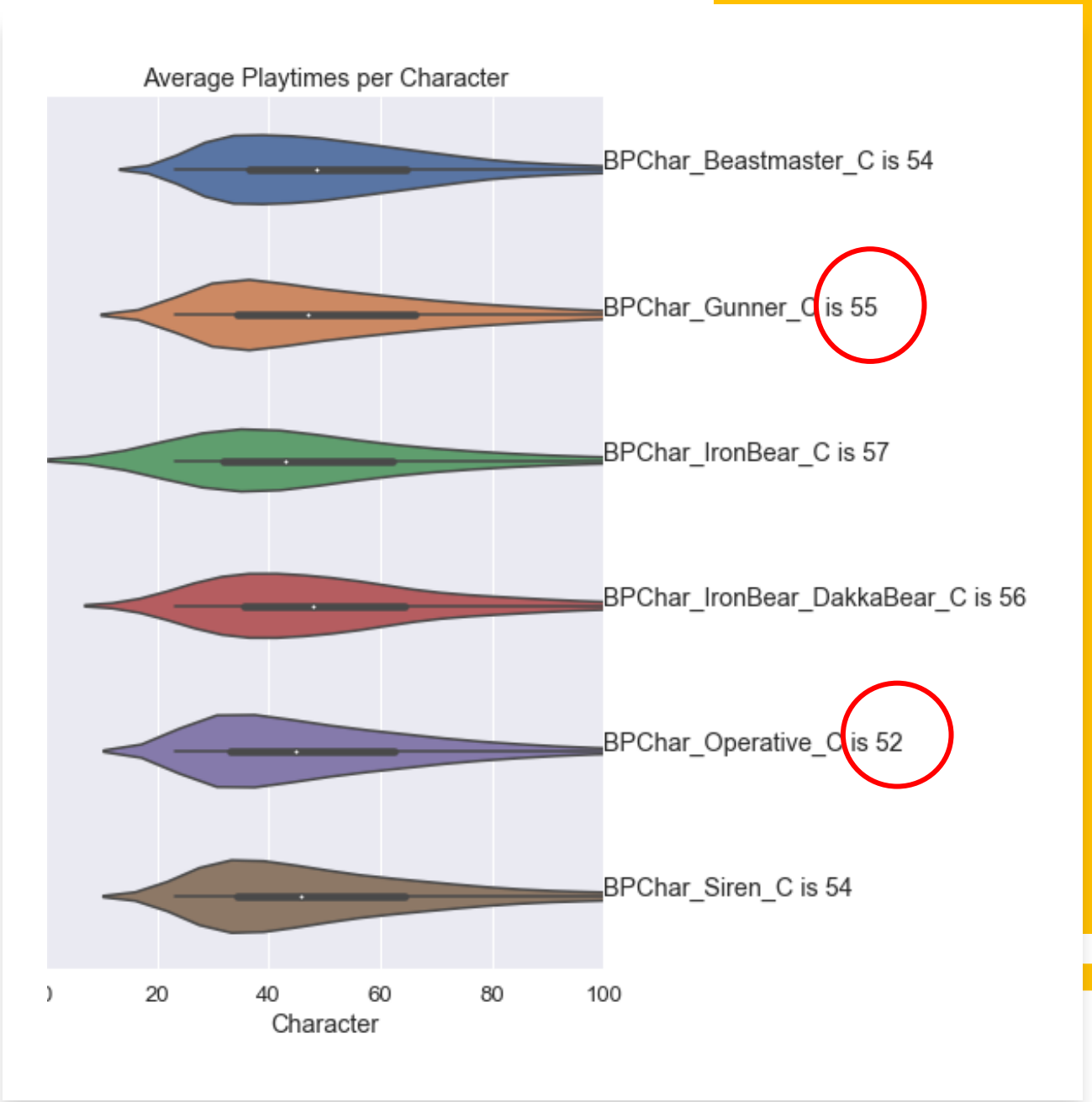


People LOVE Beast Master (FL4K)

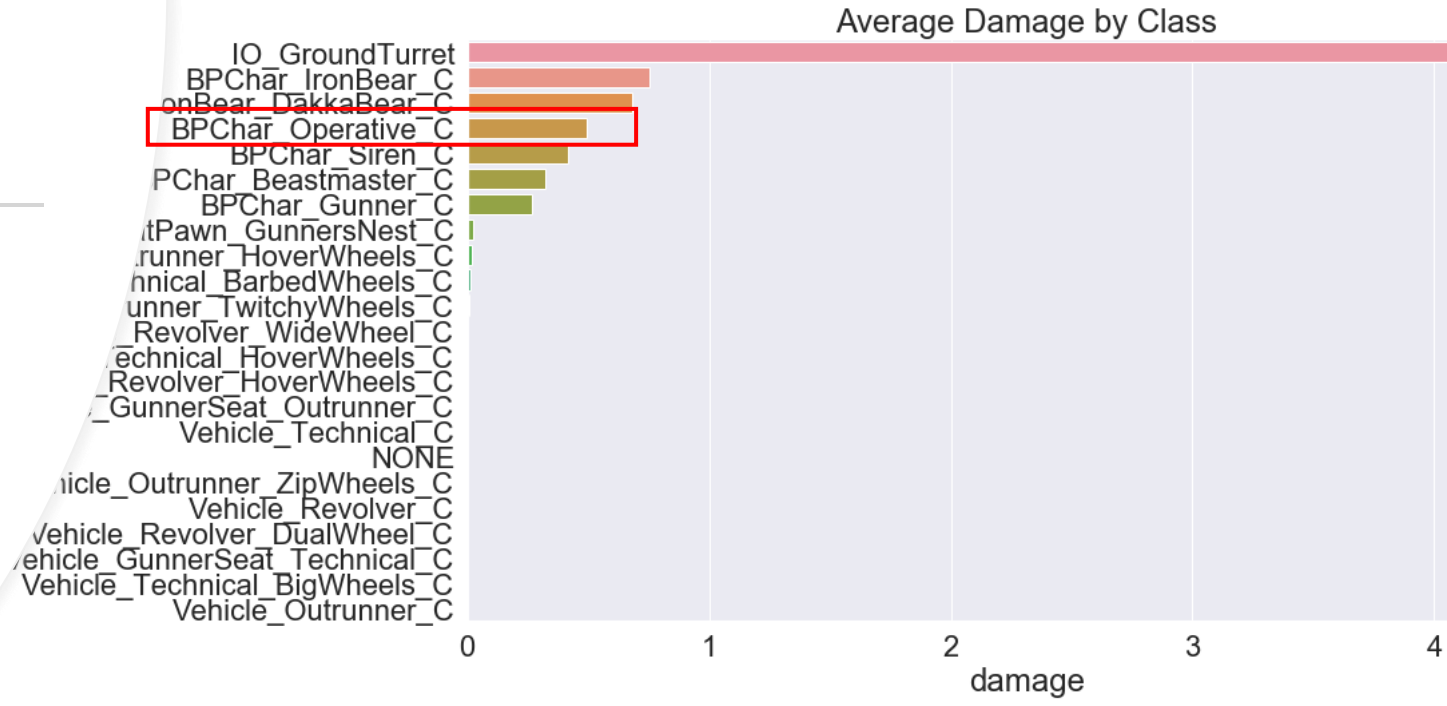
Almost 1,000 more Players than the next most

Operative comes last of 4 vault hunters

Which Vault Hunter is played for the longest



Operative (Zane) does the Most Damage



Summary on Characters

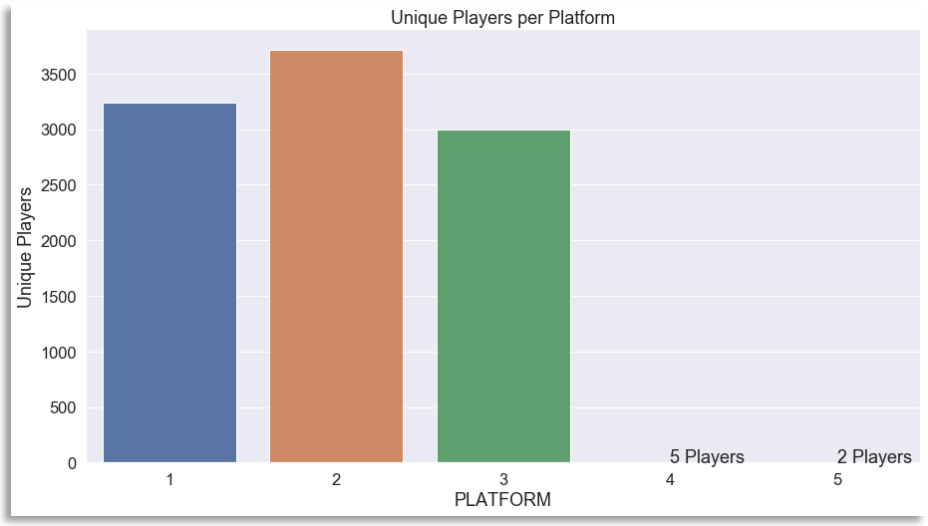
- Beastmaster has the highest number of Unique Players
  - Operative has the lowest
- Gunner is played the longest on average, while the Operative is played the shortest
  - Smaller differences. Can do statistical significance testing to follow up
- The Operative does the *most* damage on average. The Gunner does the least.
  - Possible that the Operative is difficult to master

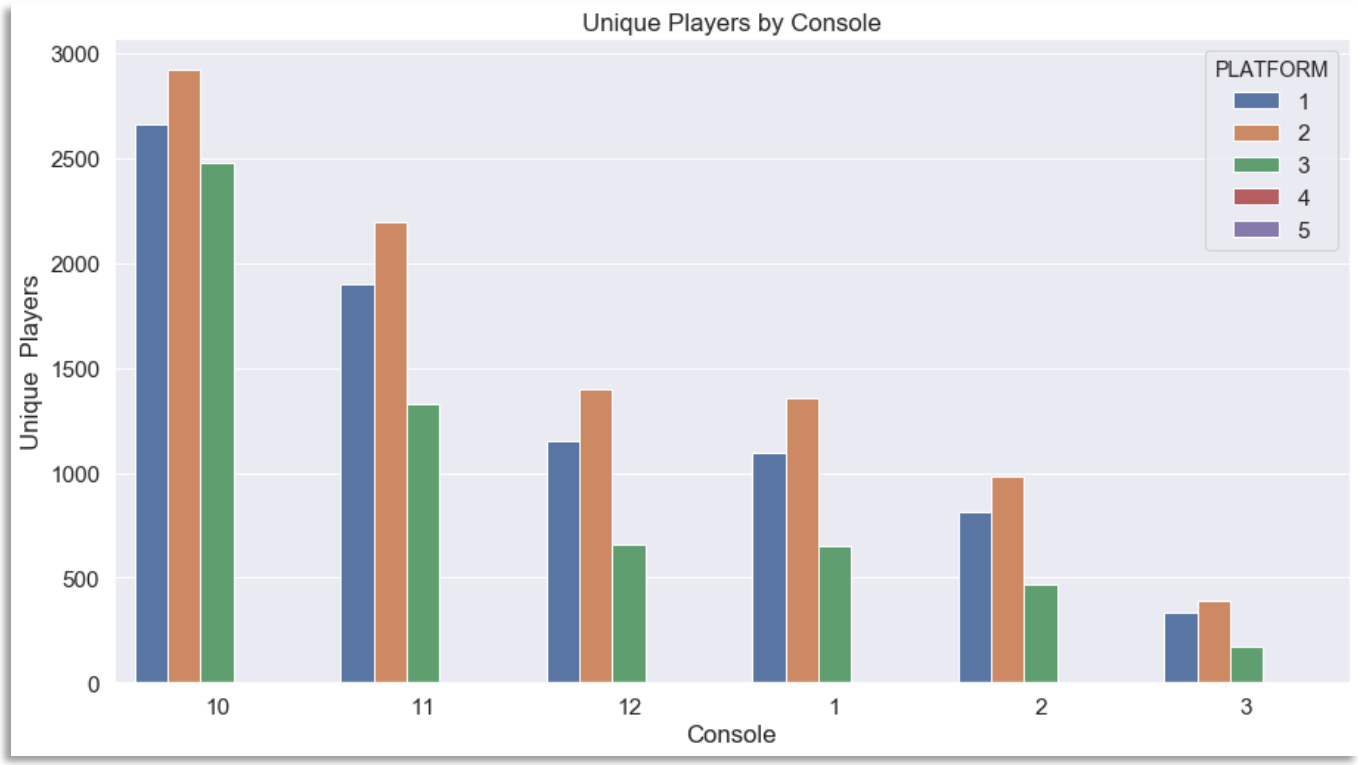
What are people using to play Borderlands 5?

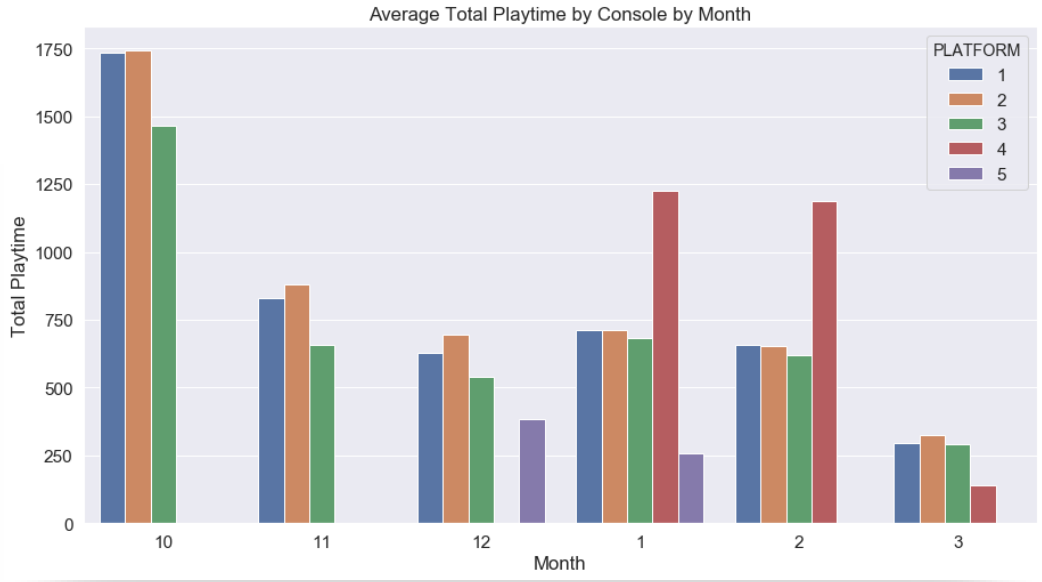
3 Platforms above the rest

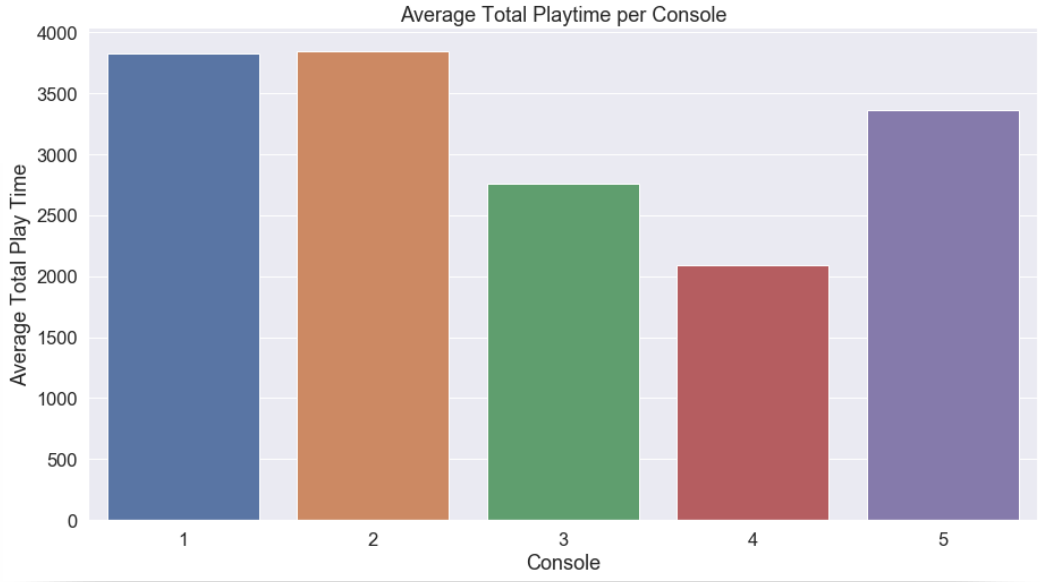
- Platform 3 starts off very strong, but quickly declines in proportion of users
  - 30% to %20 by January

MONTH	
10	30.727228
11	24.432971
1	20.861459
2	20.759717
12	20.516812
3	19.397993









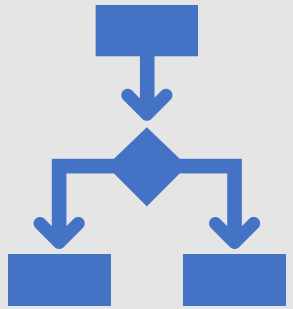
Platform User Behaviors

* Additional analyses in written form in Appendix

Summary on Platform Habits

- Platform 4 (Stadia?) didn’t release until January
  - Playtimes dropped fast though. Maybe poor experience?
- Platform 3 (PC?) started strong in platform-share but decreased in proportion
  - 30% of share to 20%
- Platforms 1 and 2 (PS4 and Xbox?) have the strongest playtimes and are roughly equal throughout

Let’s look at a subset of data



Looking at a subset of 5 hours of data

	timestamp	session_guid	hardware	map	unique_id	date
80116	1583809413	FFFF617048CA71C456C3688FDBAA4332	pc	CityVault_P	80116	2020-03-10 03:03:33
80115	1583809413	FFFF617048CA71C456C3688FDBAA4332	pc	CityVault_P	80115	2020-03-10 03:03:33
87000	1583810567	FFFF617048CA71C456C3688FDBAA4332	pc	CityBoss_P	87000	2020-03-10 03:22:47
111421	1583815148	FFFAF3DE455C6F52148BF0911709B409	xboxone	Sanctuary3_P	111421	2020-03-10 04:39:08
87488	1583810652	FFFA494E4EEFF9F8AB3499A20ED2429E	xboxone	WetlandsBoss_P	87488	2020-03-10 03:24:12
81032	1583809563	FFFA494E4EEFF9F8AB3499A20ED2429E	xboxone	WetlandsBoss_P	81032	2020-03-10 03:06:03

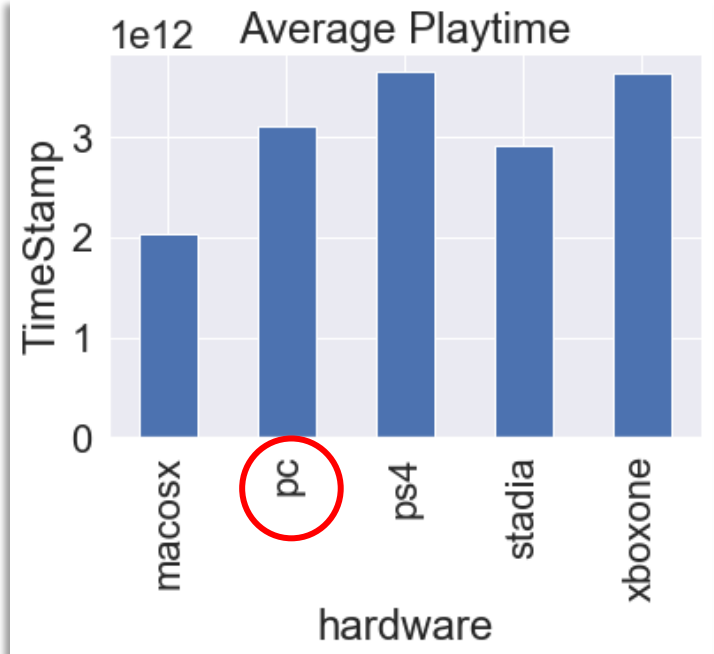
Session ID: Can appear more than once

Created to join weapons table

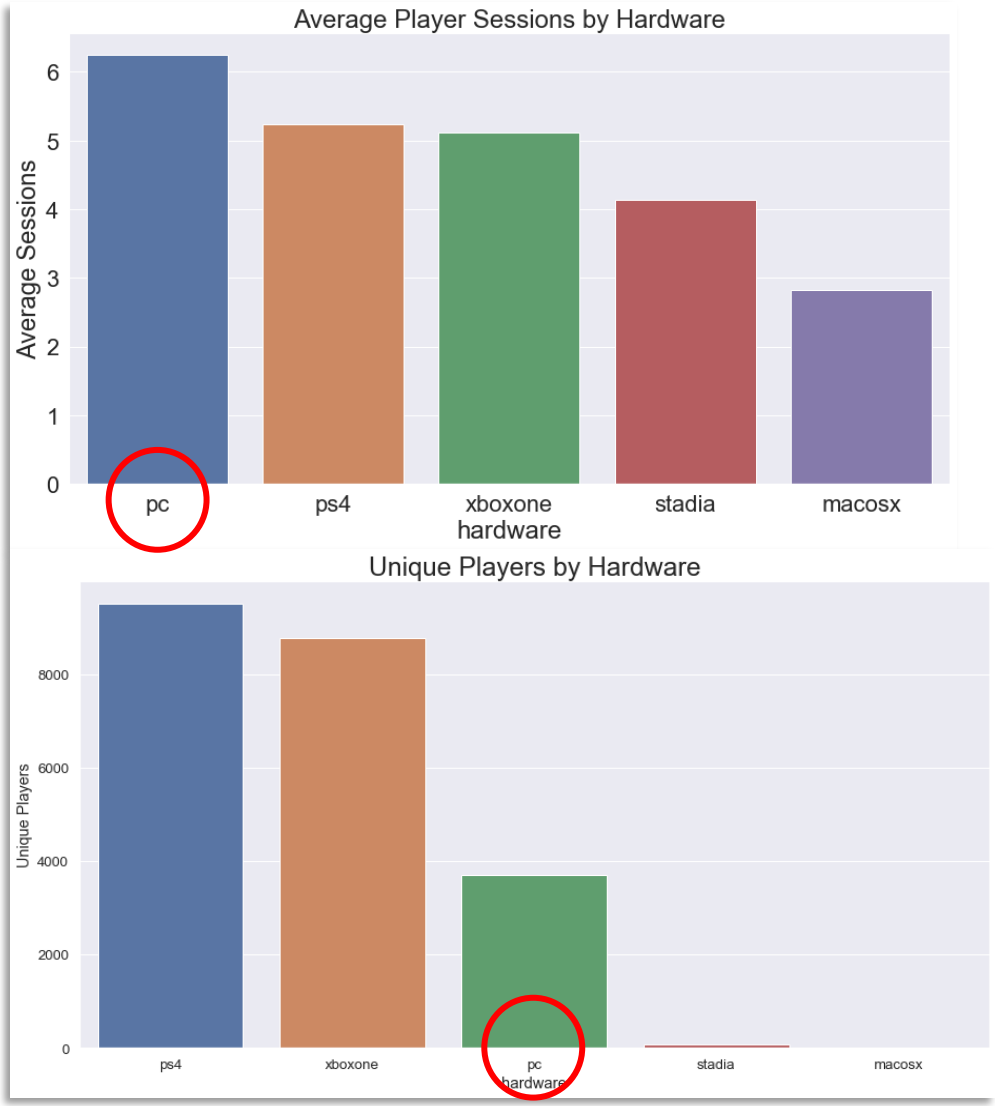
Created from timestamp: 5 hours of data

Checking the specifics

Less PC Players… but they're better?




```
hardware
ps4        0 days 01:00:57.597203238
xboxone    0 days 01:00:49.542141230
pc         0 days 00:51:59.886425094
stadia     0 days 00:48:43.653846153
macosx     0 days 00:33:47.411764705
```



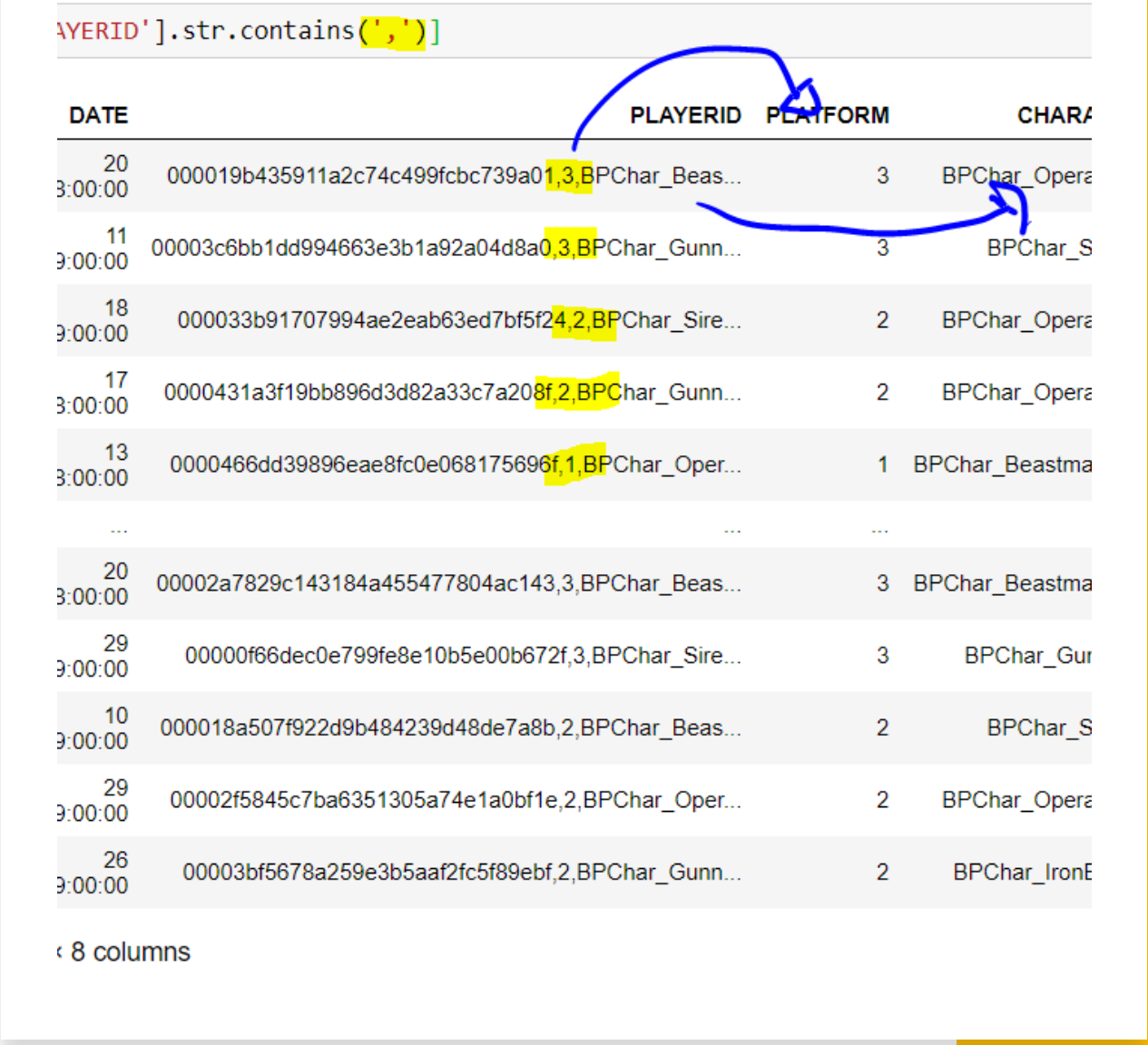
Final Recommendations

Appendix

- Data Cleaning Steps taken
- Additional Analyses for slides

The CSV

- 1,700,000 rows; 500,000 corrupted
  - Almost 1/3… can't drop these
- What's wrong with them?
  - Data in many columns shifted several cells over
- Coincidence?
  - There were also ~500,000 rows in the "clean" data with *extra* rows of data within a single cell!
  - Because of the similarity in numbers, I came to the conclusion that the 500,000 corrupted rows of data were caused because of these rows
- Rest of the clean data was ingested into **Python**

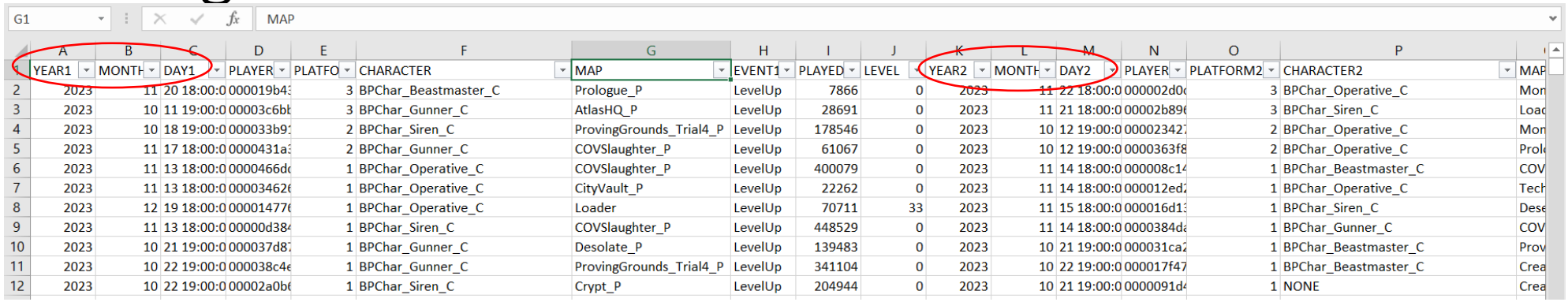


```
AYERID'].str.contains(',')]
```

DATE	PLAYERID	PLATFORM	CHARA
20 3:00:00	000019b435911a2c74c499fcbc739a01,3,BPChar_Beas...	3	BPChar_Opera
11 9:00:00	00003c6bb1dd994663e3b1a92a04d8a0,3,BPChar_Gunn...	3	BPChar_S
18 9:00:00	000033b91707994ae2eab63ed7bf5f24,2,BPChar_Sire...	2	BPChar_Opera
17 3:00:00	0000431a3f19bb896d3d82a33c7a208f,2,BPChar_Gunn...	2	BPChar_Opera
13 3:00:00	0000466dd39896eae8fc0e068175696f,1,BPChar_Oper...	1	BPChar_Beastma
...	...	...	
20 3:00:00	00002a7829c143184a455477804ac143,3,BPChar_Beas...	3	BPChar_Beastma
29 9:00:00	00000f66dec0e799fe8e10b5e00b672f,3,BPChar_Sire...	3	BPChar_Gur
10 9:00:00	000018a507f922d9b484239d48de7a8b,2,BPChar_Beas...	2	BPChar_S
29 9:00:00	00002f5845c7ba6351305a74e1a0bf1e,2,BPChar_Oper...	2	BPChar_Opera
26 9:00:00	00003bf5678a259e3b5aaf2fc5f89ebf,2,BPChar_Gunn...	2	BPChar_IronE

‹ 8 columns

Cleaning in Excel



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	
1	YEAR1	MONTH	DAY1	PLAYER	PLATFO	CHARACTER	MAP	EVENT1	PLAYED	LEVEL	YEAR2	MONTH	DAY2	PLAYER	PLATFORM2	CHARACTER2	MAP
2	2023	11	20 18:00:0	000019b4	3	BPChar_Beastmaster_C	Prologue_P	LevelUp	7866	0	2023	11	22 18:00:0	000002d0	3	BPChar_Operative_C	Mor
3	2023	10	11 19:00:0	00003c6b	3	BPChar_Gunner_C	AtlasHQ_P	LevelUp	28691	0	2023	11	21 18:00:0	00002b89	3	BPChar_Siren_C	Loac
4	2023	10	18 19:00:0	000033b9	2	BPChar_Siren_C	ProvingGrounds_Trial4_P	LevelUp	178546	0	2023	10	12 19:00:0	00002342	2	BPChar_Operative_C	Mor
5	2023	11	17 18:00:0	0000431a	2	BPChar_Gunner_C	COVSlaughter_P	LevelUp	61067	0	2023	10	12 19:00:0	0000363f8	2	BPChar_Operative_C	Prol
6	2023	11	13 18:00:0	0000466d	1	BPChar_Operative_C	COVSlaughter_P	LevelUp	400079	0	2023	11	14 18:00:0	000008c14	1	BPChar_Beastmaster_C	COV
7	2023	11	13 18:00:0	00003462	1	BPChar_Operative_C	CityVault_P	LevelUp	22262	0	2023	11	14 18:00:0	000012ed2	1	BPChar_Operative_C	Tech
8	2023	12	19 18:00:0	00001477	1	BPChar_Operative_C	Loader	LevelUp	70711	33	2023	11	15 18:00:0	000016d13	1	BPChar_Siren_C	Dese
9	2023	11	13 18:00:0	00000d38	1	BPChar_Siren_C	COVSlaughter_P	LevelUp	448529	0	2023	11	14 18:00:0	0000384d	1	BPChar_Gunner_C	COV
10	2023	10	21 19:00:0	000037d8	1	BPChar_Gunner_C	Desolate_P	LevelUp	139483	0	2023	10	21 19:00:0	000031ca	1	BPChar_Beastmaster_C	Prov
11	2023	10	22 19:00:0	000038c4	1	BPChar_Gunner_C	ProvingGrounds_Trial4_P	LevelUp	341104	0	2023	10	22 19:00:0	000017f47	1	BPChar_Beastmaster_C	Crea
12	2023	10	22 19:00:0	00002a0b	1	BPChar_Siren_C	Crypt_P	LevelUp	204944	0	2023	10	21 19:00:0	0000091d	1	NONE	Crea

- Brought corrupted rows into excel to work in real time with them
- Split by commas and made a table with two tables' worth of columns
- Brought the data into python and split them into two tables, renaming for consistency

```
df21 = df2[['YEAR1','MONTH1','DAY1','PLAYERID1','PLATFORM1','CHARACTER','MAP','EVENT1','PLAYEDTIME','LEVEL']]
```

```
df21.rename({'YEAR1':'YEAR', 'MONTH1':'MONTH','DAY1':'DAY','PLAYERID1':'PLAYERID','PLATFORM1':'PLATFORM','CHARACTER1':'CHARACTER
             'MAP1':'MAP','EVENT1':'EVENT','PLAYEDTIME1':'PLAYEDTIME','LEVEL1':'LEVEL'}, axis = 1, inplace = True)
```

Bringing it together

- Used Python to bring all of the data together
- There were still some issues with the data. Some outliers and corrupted data, but only <1%
  - Examples: Data remaining in wrong row
    - Used RegEx and Type constraints to find them
  - Dropped them
- Result: 1.7 mil clean rows of data

```
full_data = pd.concat([no_errors, df21, df22_
```

```
full_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 1742721 entries, 0 to 508985
Data columns (total 10 columns):
YEAR          object
MONTH         object
DAY           object
PLAYERID      object
PLATFORM      object
CHARACTER     object
MAP           object
EVENT         object
PLAYEDTIME    float64
LEVEL         float64
dtypes: float64(2), object(8)
memory usage: 146.3+ MB
```

The JSON file

- The JSON was a clean dataset, but needed to be worked on for Python and Jupyter Notebook use
- Created two tables: one for ‘context’ and one for ‘weapons’
  - Assigned Unique Identifier for each JSON line
- 5 Hours worth of Data
- ~100,000 in context and 1,000,000 in weapons

	timestamp	session_guid	hardware	map	unique_id
0	1583797550	180237AD47320869A9F18CAE3B149753	pc	City_P	0
1	1583797550	0B7152ED08D7C44BF565BA0A0A05DE46	ps4	OrbitalPlatform_P	1
2	1583797550	0C5886A808D7C466611743330B3CF5E3	ps4	Watership_P	2
3	1583797550	0BD437A408D7C457E71407DA0A687388	ps4	OrbitalPlatform_P	3
4	1583797550	DEB3B53A4677DB2AC377498E9283E10E	xboxone	MarshFields_P	4
...	...	...	...	...	...
118199	1583816535	22C533B2485A92B39CBCF7973C7984EC	xboxone	Sanctuary3_P	118199
118200	1583816536	C2FF691548C47653B0D4E6BE93A89697	xboxone	Wetlands_P	118200
118201	1583816536	D11852E243CFD562CC0FF7A4B67BC4A0	xboxone	WetlandsBoss_P	118201
118202	1583816536	0C64731008D7C5074F29482A08FF25A2	ps4	Sanctuary3_P	118202
118203	1583816536	7A4886D44016791E9795C7AE63E97E24	xboxone	Beach_P	118203

118204 rows × 5 columns

	class	fired	criticals	hits	damage	aoe_damage	crit_damage	reloads	trigger_pulls	type	unique
0	BPChar_Operative_C	66	1	None	891130.00	0.00	35231.0	0	33	WT_PS_MAL	
1	BPChar_Operative_C	0	0	None	4107.09	0.00	0.0	0	0	DamageSource	
2	BPChar_Operative_C	0	0	None	50678.40	0.00	0.0	0	0	DamageSource_Skill_Operative_Drone_C	
3	BPChar_Operative_C	0	0	None	0.00	5995.50	0.0	0	0	DamageSource_Grenade_C	
4	BPChar_Operative_C	0	0	None	0.00	6187.67	0.0	0	0	DamageSource_GrenadeDoT_C	
...	...	...	...	...	...	...	...	...	...	...	
1070496	BPChar_Siren_C	0	0	None	5053.65	0.00	0.0	0	0	DamageSource_StatusEffect_C	118
1070497	BPChar_Siren_C	4	0	None	76638.10	17154.50	0.0	2	2	WT_SG_MAL	118
1070498	BPChar_Siren_C	0	0	None	301807.00	1181890.00	0.0	0	0	DamageSource_Bullet_Shotgun_C	118
1070499	BPChar_Siren_C	0	0	None	1290490.00	347745.00	0.0	0	0	DamageSource_Bullet_C	118
1070500	BPChar_Siren_C	0	0	None	0.00	10103.10	0.0	0	0	DamageSource_Skill_C	118

1070501 rows × 11 columns

Unique Players per Month

- Peak single-day Unique Users just after launch at 5,000+
- Has decreased to ~400 per day, 5 months after release
- Peaks on the weekends

How Long are People Playing?

- Players are likely to spend almost 3,000 minutes (50 hours) total in the world of borderlands
- Most playing sessions are roughly an hour, but many extend to 2 or 3

Playtime by Month

- Total Playtime heavily decreased by November, but increased again in January. Winter break?
- There is not a large different in average session over time. So even if less people are playing, they are still spending just as long playing

Platform User Behaviors

- The top two consoles (at this point I’m suspecting PS4 and Xbox), are played with similar habits
- Console 4 (I’m suspecting the Stadia) increases in January because it was released then
  - Quickly decreases. Not working well?

Less PC Players… but they're better?

- There are only half the amount of PC players than PS4 and Xbox One players
- They "get more done" though, and in less time
- More experienced? Faster load times?