Fintech Applications in Fantasy Football

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What is Fantasy Football?

In most basic form, Fantasy Football is a game which is played by choosing a team/roster of football players, with the goal of scoring more than your opponents' team.

- Players selected for fantasy football teams are "real-life" players on various real-life teams that earn fantasy points based on their real-life performance on the field. Various actions occurring in real-life games, such as catching a pass or scoring a touchdown, increase the players' fantasy scores.
- Fantasy football can be played on a variety of online platforms such as ESPN, Yahoo, Fanduel and DraftKings. Fantasy Football is played both for fun and for cash prizes.
- Fantasy football is played in a variety of formats, with varying rules around the number of players on a team, the number of games and scoring. Two of the most popular forms include:
    - Daily Fantasy Football - Select the best (highest scoring) team of players. Players will score fantasy football points only for games occuring on a given day. The fantasy team that scores the most fantasy points for that day wins.
    - Season Long Fantasy Football - Select the best (highest scoring) team of players. Players score fantasy football points each week over the course of a season (generally 13 weeks). The fantasy team that scores the most fantasy points over the course of the season wins.

From Finance to Fantasy

A number of quantitative concepts utilized in financial analysis and portfolio management are adaptable for use in fantasy football.

	Finance	Fantasy Football
Assets:	Stocks, Bonds, Currencies	Individual Players (with multiple positions such as QB, RB, TE and WR)
Portfolio:	A collection of assets	A team/roster of individual players
Goals:	Maximize returns, given constraints around portfolio construction, budgets and risk	Maximize fantasy points, given constraints around roster construction, budgets and player volatility
Tools:	• Historic performance analysis • Future performance projections • Optimization packages	• Historic performance analysis • Future performance projections • Optimization packages

Application 1: Betting on a Fantasy Football Team

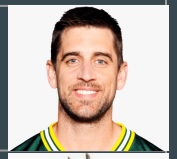
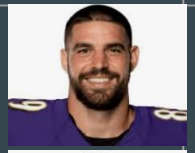
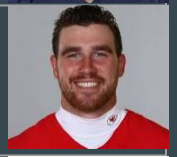
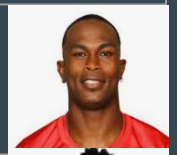
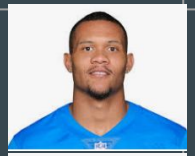
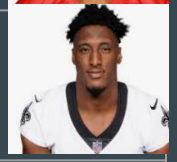
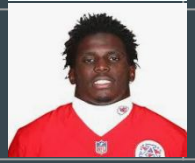
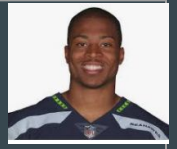
Your friend claims his fantasy football team is better than yours! After selecting teams in your league draft, he suggests that you make a bet: if his team scores more points than your team over the course of a 13 game season, you have to pay him $100. If your team scores more than his over the course of the season, then he will pay you $100.

- How do your teams stack up historically?
- Which team do you expect to do better over the course of a season?
- Should you take the bet? Why or why not?
- What is a better bet for you to make?

Everyone else's Team

My Team

Betting on a Fantasy Football Team

Position	Roster 1 (Your Friend)		Roster 2 (You)	
QB	Drew Brees		Aaron Rodgers	
RB	Alvin Kamara		Aaron Jones	
RB	Christian Mccaffrey		Derrick Henry	
TE	Mark Andrews		Travis Kelce	
WR	A.J. Brown		Julio Jones	
WR	Kenny Golladay		Michael Thomas	
WR	Tyreek Hill		Tyler Lockett	

Betting on a Fantasy Football Team

At first, glance the teams look fairly even, with each team having its pros and cons:

- QB: Drew Brees and Aaron Rodgers are considered two of the best quarterbacks in the NFL, things look fairly even here.
- RB: Based on the games you have been watching, it seems like your friend's team is slightly better at this position.
- TE: Both teams have solid tight ends on good offenses. Things look about even here.
- WR: Your WR's have been lighting it up this year, you feel confident your wide receivers are better than your opponents.

Watching games and players can only go so far... time to dive into the numbers!

Position	Player	Team	Points
QB	Drew Brees	NO	20.477647
RB	Alvin Kamara	NO	19.008649
	Christian McCaffrey	CAR	23.628571
TE	Mark Andrews	BAL	8.897368
WR	A.J. Brown	TEN	13.095455
	Kenny Golladay	DET	12.668571
	Tyreek Hill	KC	16.750000

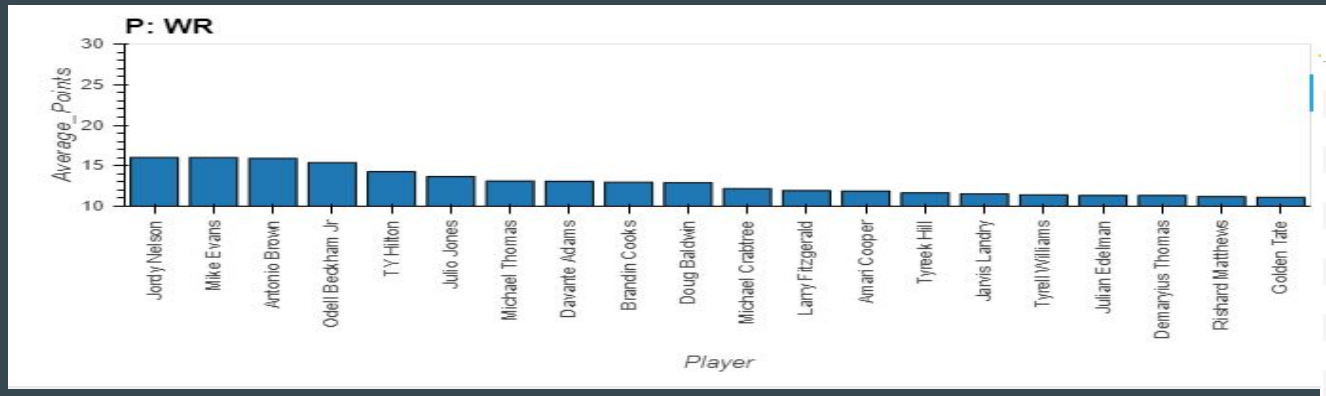
Position	Player	Team	Points
QB	Aaron Rodgers	GB	19.627000
RB	Aaron Jones	GB	16.620588
	Derrick Henry	TEN	16.022051
TE	Travis Kelce	KC	14.360976
WR	Julio Jones	ATL	15.715789
	Michael Thomas	NO	16.585294
	Tyler Lockett	SEA	13.284615

Top 20 Players at Each Position

Goal: Identify and visualize performance of top 20 players for each year for each of the 4 positions QB, WR, RB, TE

How?

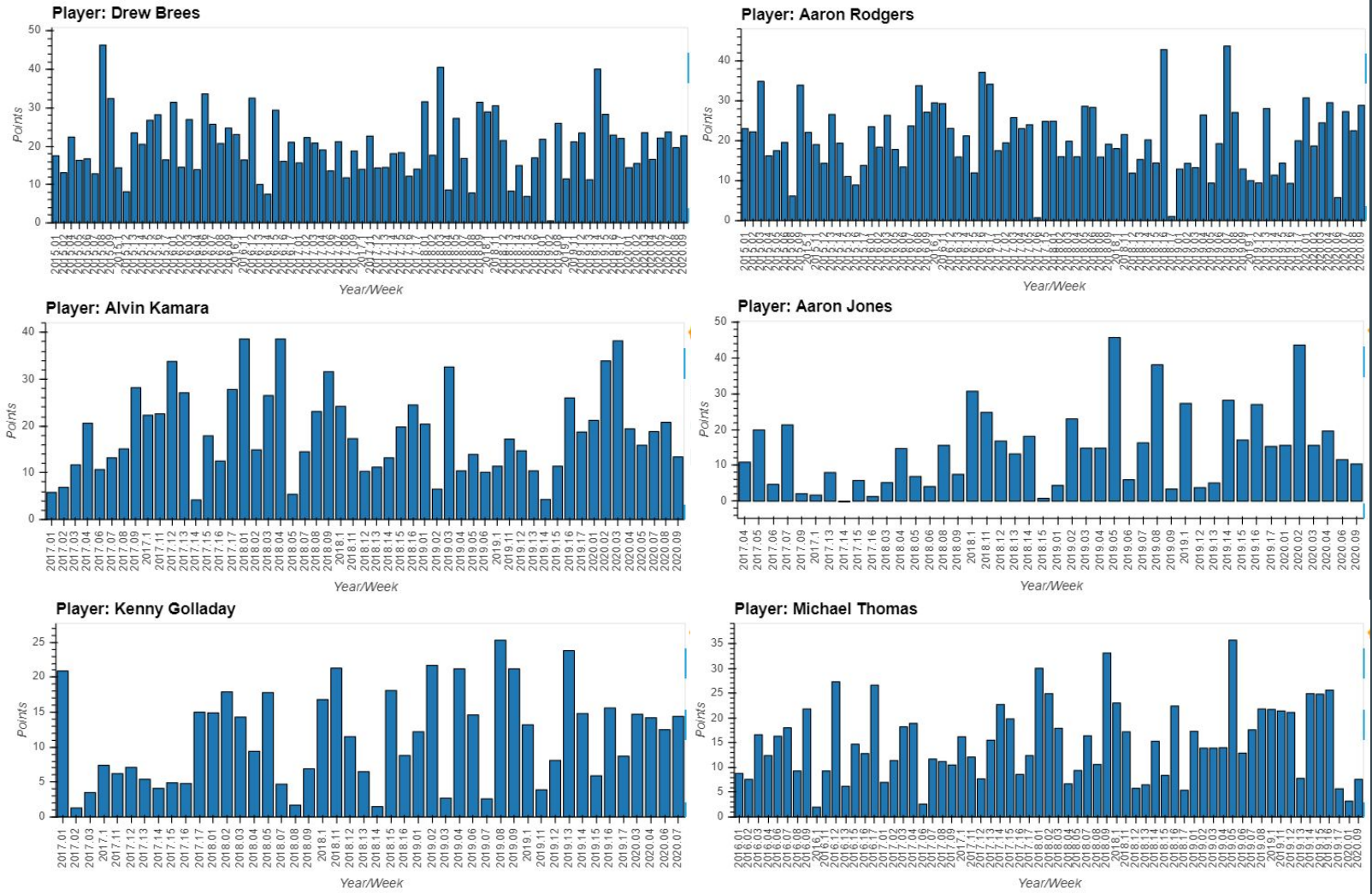
- Data from FanDual in CSV format.
- Loaded data into panda dataframe separately for each year
- Used dataframe APIs (aggregate and sort functions) to identify top 20 players based on their FD Points and position.
- Python and pyviz plot and dashboard to visualize the result



Player	P	Week	Opp Position Rank	FDSal	DKSal	FD Points	DK Points
Jordy Nelson	WR	9.3125	12.6250	7950.00	7512.50	16.01250	20.0000
Mike Evans	WR	9.1875	16.2500	8212.50	7931.25	16.00625	19.8750
Antonio Brown	WR	9.0625	17.3125	8987.50	9231.25	15.89375	20.0625
Odell Beckham Jr	WR	9.0625	17.6875	8818.75	8737.50	15.38125	19.3750
TY Hilton	WR	8.9375	14.0000	7593.75	7493.75	14.26875	18.3125
Julio Jones	WR	8.8750	18.7500	8762.50	9000.00	13.65000	17.6875
Michael Thomas	WR	9.2500	14.1875	5987.50	5468.75	13.10625	16.6875
Davante Adams	WR	9.3125	12.6250	6393.75	5231.25	13.07500	16.1875
Brandin Cooks	WR	9.2500	14.1875	7368.75	7150.00	12.95625	16.0625
Doug Baldwin	WR	9.2500	19.3125	7025.00	6425.00	12.91250	16.4375
Michael Crabtree	WR	8.9375	14.8125	6537.50	6268.75	12.17500	15.6250
Larry Fitzgerald	WR	9.0000	19.5625	7131.25	6956.25	11.93125	15.4375
Amari Cooper	WR	8.9375	14.8125	7462.50	7318.75	11.86875	15.2500
Tyreek Hill	WR	9.2500	17.5625	4693.75	4018.75	11.65625	13.6875
Jarvis Landry	WR	9.0625	16.3125	6775.00	6262.50	11.53125	15.4375
Tyrell Williams	WR	8.8750	17.3125	6125.00	4962.50	11.40000	14.1875
Julian Edelman	WR	9.0000	16.5000	6718.75	6431.25	11.33125	15.0000
Demaryius Thomas	WR	8.8750	17.3750	7175.00	6493.75	11.33125	14.7500
Rishard Matthews	WR	8.7500	17.4375	5575.00	4025.00	11.18750	13.8125
Golden Tate	WR	8.9375	13.3125	6312.50	5825.00	11.10000	14.5625

Historic Data

Historic Data



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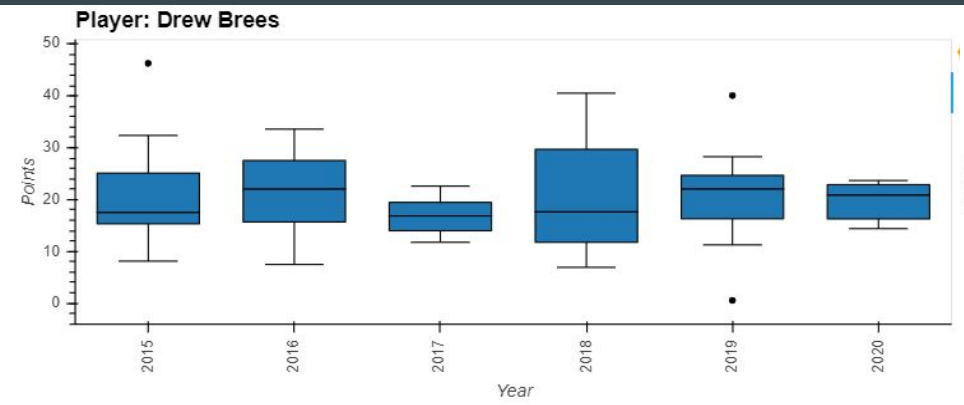

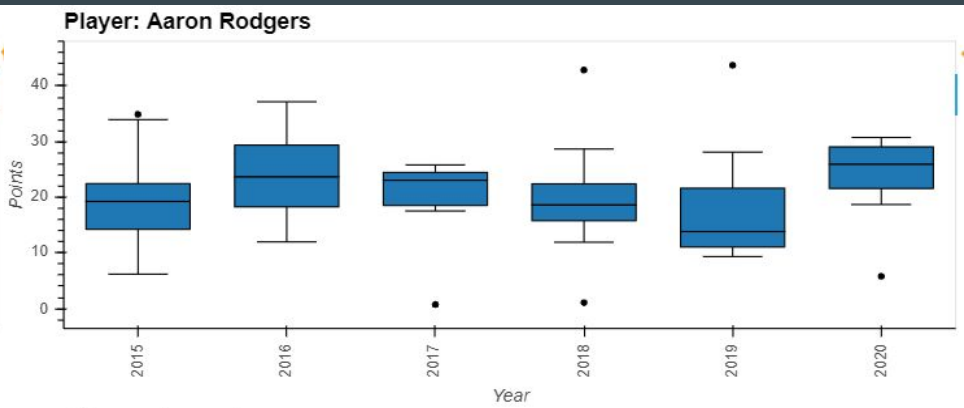

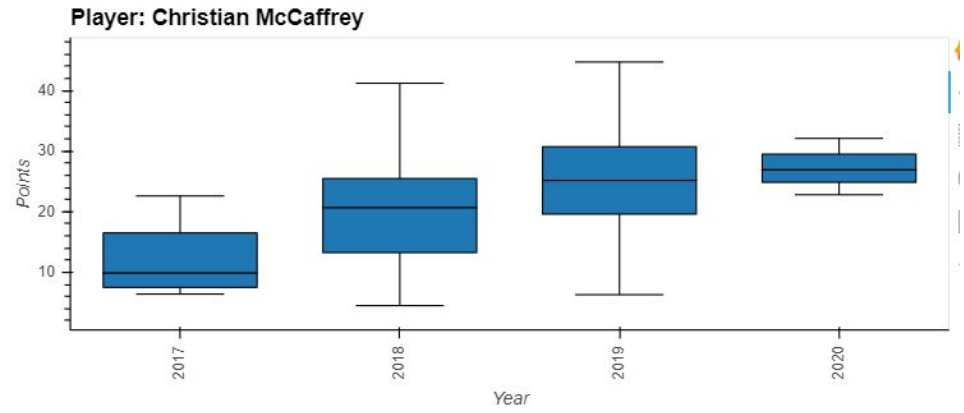

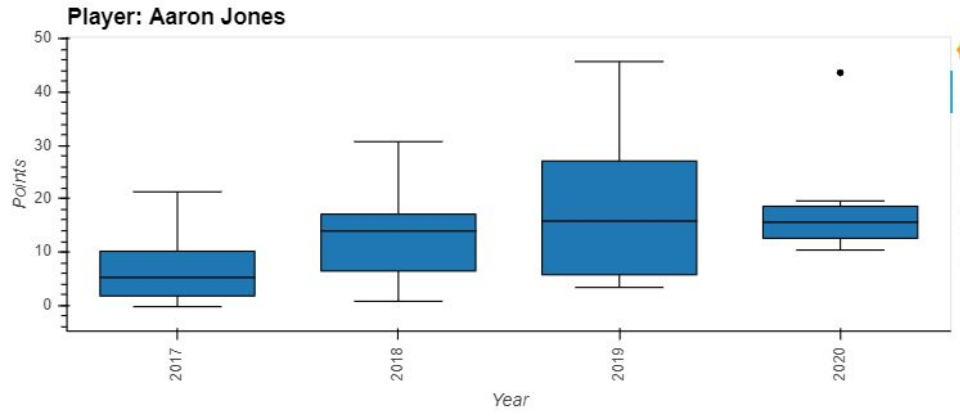

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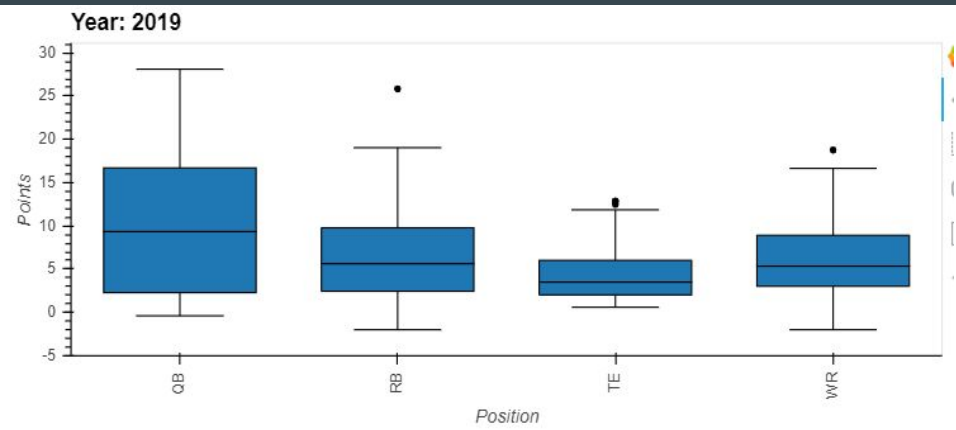

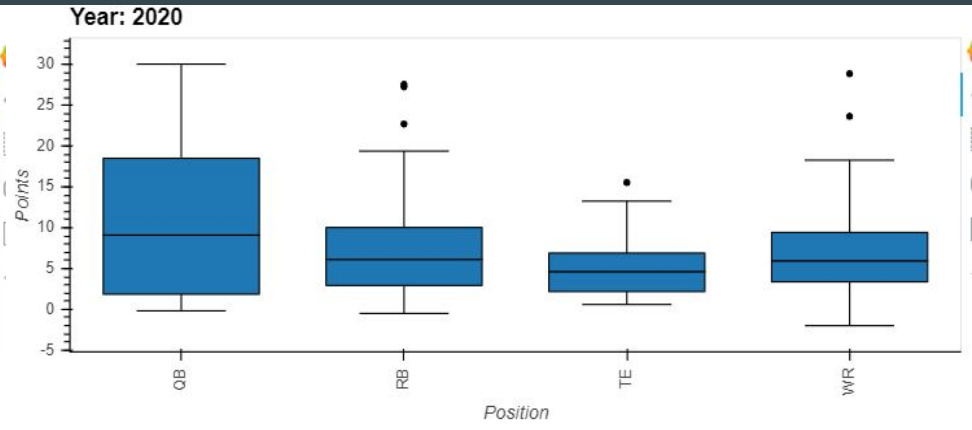

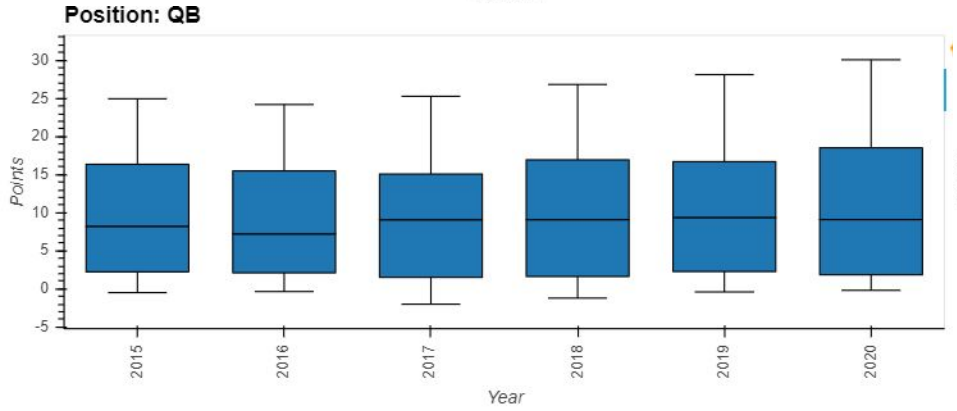

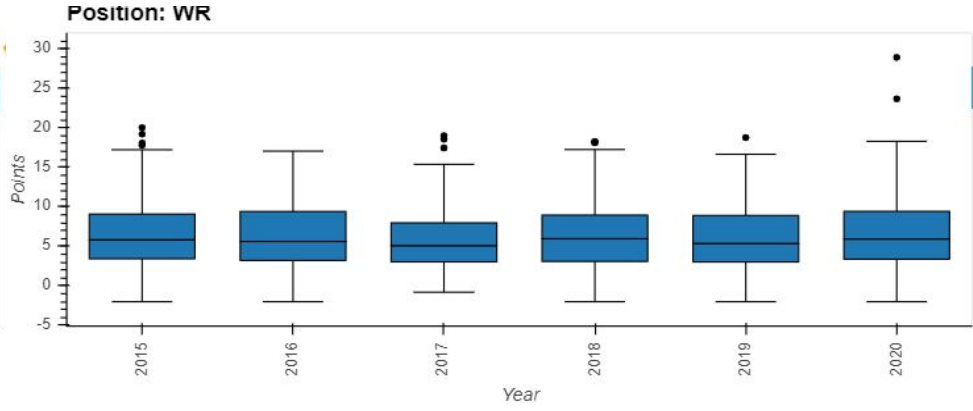

Monte Carlo Simulations

Historic Data

Average fantasy points 2018 - 2020

Position	Player	Team	Points
QB	Drew Brees	NO	20.477647
RB	Alvin Kamara	NO	19.008649
	Christian McCaffrey	CAR	23.628571
TE	Mark Andrews	BAL	8.897368
WR	A.J. Brown	TEN	13.095455
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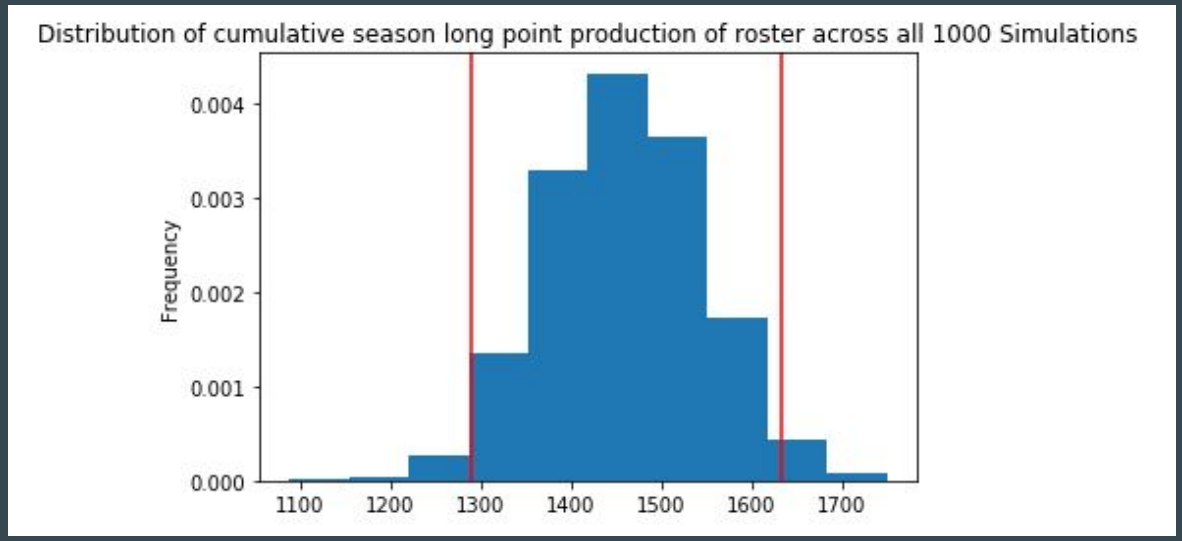
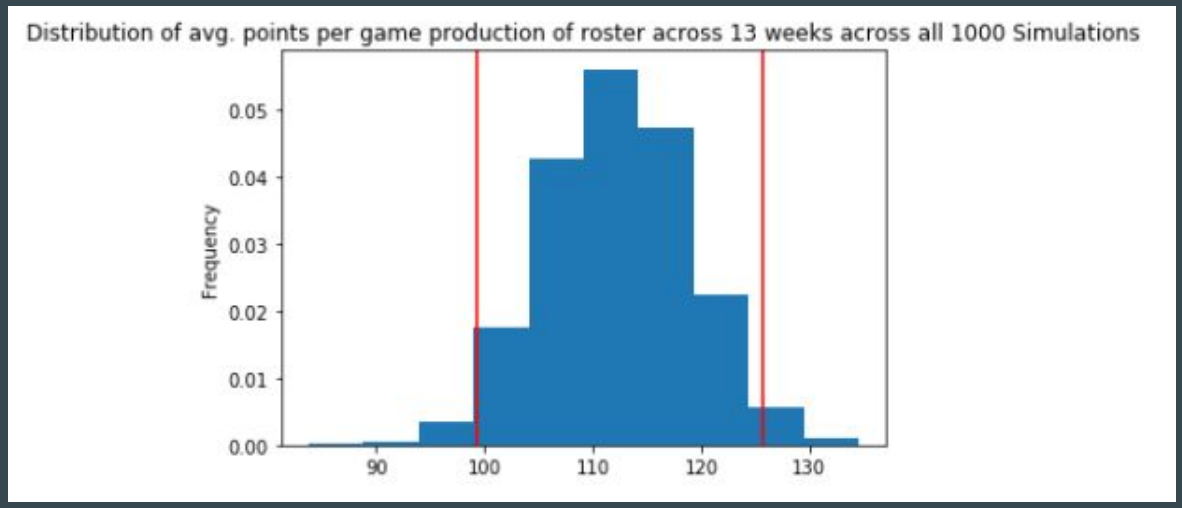
WR	Julio Jones	ATL	15.715789
	Michael Thomas	NO	16.585294
	Tyler Lockett	SEA	13.284615

1000 Simulations



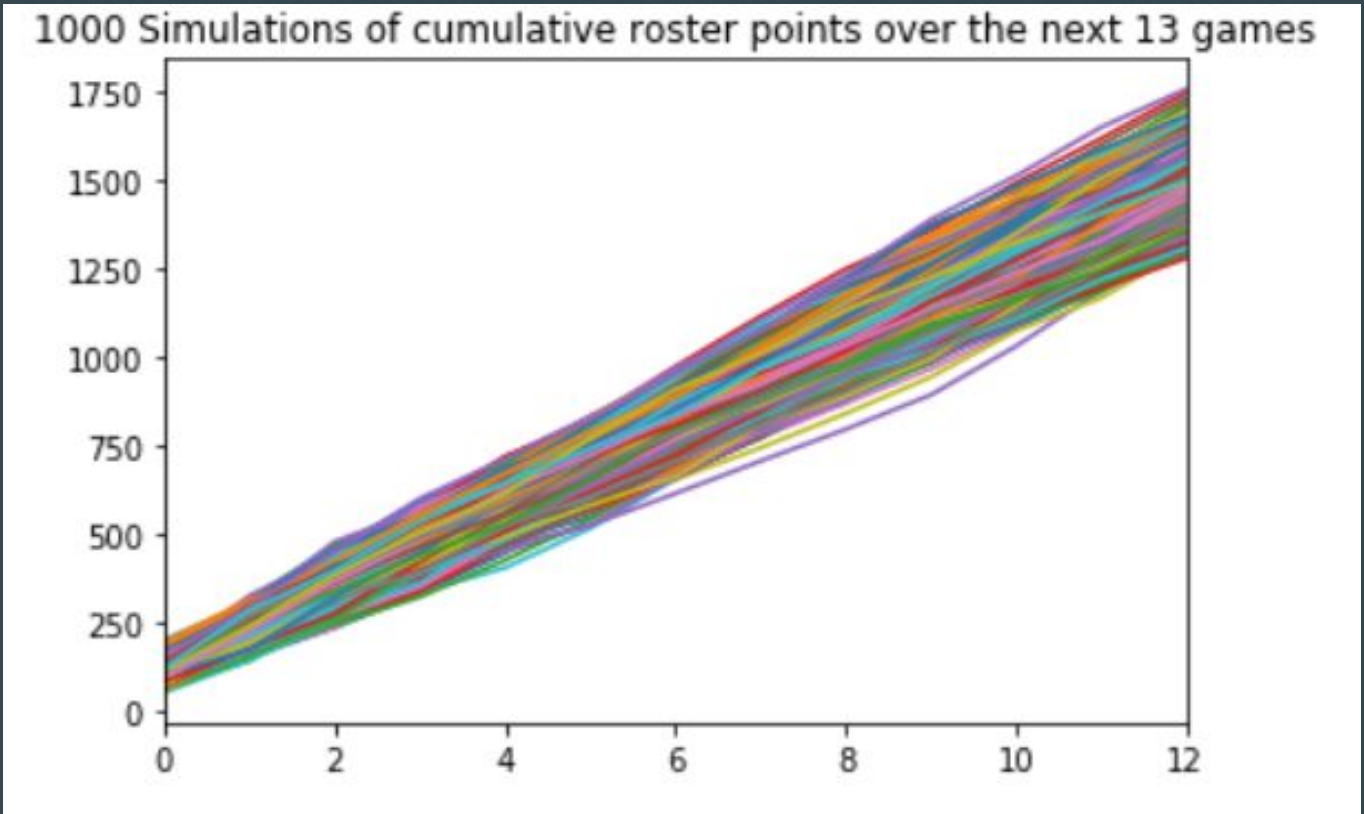

```
MC_roster1.plot_szn_distribution()
```




```
MC_roster1.plot_avg_szn_distribution()
```

Predicting the Outcome of the Next 13 Games

```
MC_roster1.plot_szn_simulation()
```



Monte Carlo Results

```
MC_roster1.summarize_szn_points()
```

count	1000.000000
mean	1490.152303
std	82.442725
min	1243.202968
25%	1432.897585
50%	1488.578065
75%	1546.515148
max	1801.122004
95% CI Lower	1331.261935
95% CI Upper	1655.838406

```
MC_roster2.summarize_szn_points()
```

count	1000.000000
mean	1458.673654
std	89.138669
min	1173.211375
25%	1394.953134
50%	1454.520123
75%	1517.648439
max	1765.820270
95% CI Lower	1292.645983
95% CI Upper	1636.550196

Name: 12, dtype: float64

```
odds_calculator(MC_roster1.szn_end_points,MC_roster2.szn_end_points)
```

```
'Roster 1 has 61.0% chance of winning fair American odds are: -156.0'
```

Do not agree to an even odds bet with your friend!!! Their team appears to be better, and is projected to win 61% of the time. A fair bet is $156 if you win, and $100 if he wins.

Application 2: Choosing the Optimal Fantasy Roster

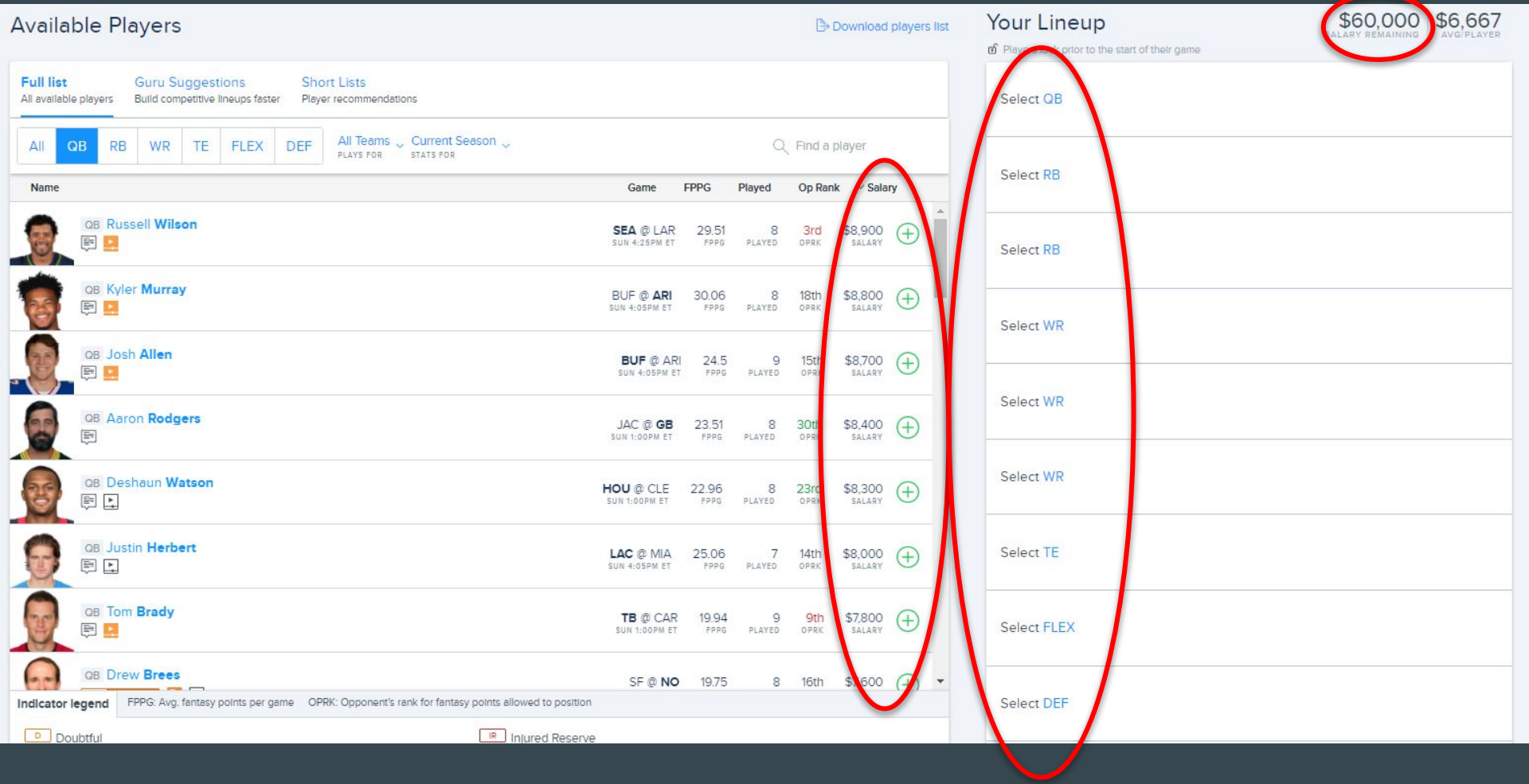
Application 2: Select An Optimal Roster

One popular fantasy football platform, Fanduel, allows players to select a fantasy football team each week. People win when their fantasy football teams score more than their oponents for that given week. Each week the contest “re-sets” with the opportunity for a new winner to be chosen based on the fantasy football team that players select for that week.

When selecting a team, players must follow certain rules or constraints around their choices:

- **Budget constraint:** each player has a “salary” to put them in your roster in total you cannot spend more than the salary cap on your roster (generally $60,000)
- **Position constraints:** each fantasy football team must have a certain number of players in each position. In general each team requires 1x QB, 2x RB, 3x WR, 1xTE, 1xFLEX (can be WR, RB, or TE) and 1x DEF (defense).

Constraint Overview



Optimizing Your Line Up

One's goal when picking a fantasy football team on Fanduel is to maximize the number of expected fantasy points, while 1) not spending more than the salary cap and also 2) filling each roster position belongs to a family of problems known as constrained optimization problems. Constrained optimization problems can generally be expressed in the form of "maximize or minimize an objective function subject to a series of constraints". When choosing a fantasy football team, individuals are faced with the following constrained optimization problem:

Objective Function: Maximize expected number of fantasy points

Constraints:

1. Do not spend more than $60,000
2. Roster must have 1x QB, 2x RB, 3x WR, 1x TE, 1x FLEX and 1x DEF

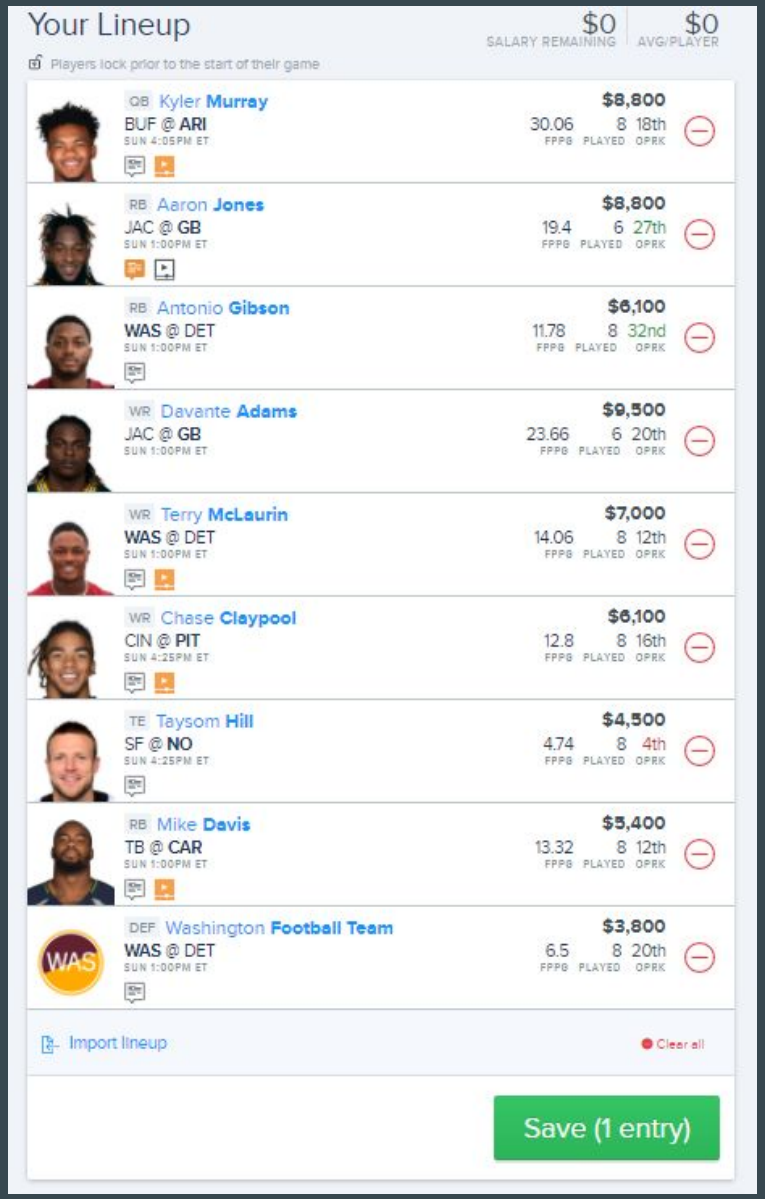
PuLP for Optimization

PuLP for python is an optimization tool for Python which can be utilize to define and solve constrained optimization problems. In order to choose the best Fanduel roster, we set up a PuLP problem which maximizes the number of expected points, while satisfying the budget constraints and filling all necessary positions.

```
Optimal Roster:
----------------------------------------

D_Washington_Football_Team
QB_Kyler_Murray
RB_Aaron_Jones
RB_Antonio_Gibson
RB_Mike_Davis
TE_Taysom_Hill
WR_Chase_Claypool
WR_Davante_Adams
WR_Terry_McLaurin
----------------------------------------

Budget Constraint Overview:
3800*1.0 + 8800*1.0 + 8800*1.0 + 6100*1.0 + 5400*1.0 + 4500*1.0 + 6100*1.0 + 9500*1.0 + 7000*1.0 = 60000.0
----------------------------------------

Projected Fantasy Points:
7.1*1.0 + 24.2*1.0 + 19.4*1.0 + 13.0*1.0 + 13.4*1.0 + 14.4*1.0 + 12.7*1.0 + 20.3*1.0 + 15.3*1.0 = 139.8
```

Optimal Fanduel Roster

With the output from the Fanduel roster optimization algorithm we were able to select the roster to the right, which has the highest projected points and uses all of the available salary.



May all of your fantasy football fantasies come true EXCEPT for the one where you beat my team.

someecards

Fanduel API

We utilized Fanduel as our primary data source. The data was downloaded as CSV files and were read into dataframes by year. We concatenated these to create one dataframe that encompassed all of our data.

Cleaning our data:

To prevent skewing of our data due to “0” values (which would occur if a player is injured or did not play in a game), we created a filter called [non_points] to exclude those data points. We also checked for null values in our data.

Appendix: Data Sources and Resources

https://www.fantasypros.com/nfl/rankings/half-point-ppr-wr.php

http://nflsavant.com/

https://randerson112358.medium.com/python-for-finance-portfolio-optimization-66882498847

https://medium.com/ml-everything/using-python-and-linear-programming-to-optimize-fantasy-football-picks-dc9d1229db81

https://coin-or.github.io/pulp/main/index.html

https://dailyroto.com/nfl-historical-production-fantasy-points-draftkings-fanduel/

https://www.isaacslavitt.com/posts/linear-optimization-in-python/