Running Backs On the Hotseat?

An analysis on the contributions of NFL running backs to team success and to what extent running backs should be valued

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OA3801 Final Project

Scouting Report

BREAKING NEWS

13 July 2023: "Why star NFL running backs have been devalued: What's next"

18 July 2023: "Derrick Henry, Jonathan Taylor among many star RBs angry about Saquon Barkley, Josh Jacobs franchise tags"

23 July 2023: "Star NFL RBs meet on Zoom to talk financial state of position"

24 August 2023: "NFL running back controversy explainer: Why Jonathan Taylor, Josh Jacobs, others take issue with pay structure"

1 September 2023: "Titans' Derrick Henry on RBs: 'Just trying to show that we are as valuable as any other position'"

Coach's Speech

- Football season is BACK
- RBs are on the hotseat coming into this season due to multiple RB stars holding out for more money
- Are RB's worth the money they're asking for?

Goal: Compare player production and team success with how much the position and its members are getting paid

Pre-Game Warm Up

- 32 NFL Teams
- 10 Years (2013-2022)
- Data:
  - pro-football-reference.com
  - overthecap.com
- Packages: Pandas, Openpyxl, Matplotlib, Plotly
- Languages: Python, R

Coin Toss
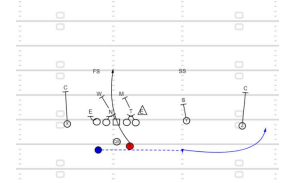
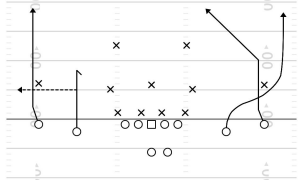$RB = Running\ Back$

$WR = Wide\ Receiver$

$TE = Tight\ End$

$Skill\ Positions = \{RB,\ WR,\ TE\}$

$$RB\ Ratio = \frac{Total\ RB\ Salary\ (USD)}{Total\ Offense\ Salary\ (USD)}$$

$$RB\ Skill\ Ratio = \frac{Total\ RB\ Salary\ (USD)}{Total\ Skill\ Position\ Salary\ (USD)}$$

Playbook

Data Curation

Datasets in Excel Workbook format (RB rushing/ receiving by team & year, wins/loss, team budgets)

↓

Parse and clean up data

↓

Complete merges and create pivot table to view data for all 32 teams

Computation

Analyze data at the player and team levels over the last 10 years

↓

Correlation between rushing yards in a season and points/team wins
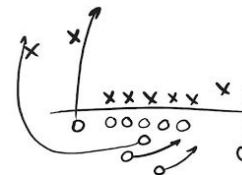
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Correlation between RB rushing yards & pay

Results

Interactive Visuals

↓

Financial Analysis
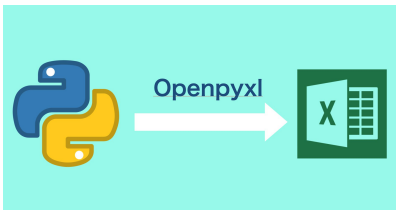
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Impact of RBs on team wins

Kickoff: Data Sources & Curation Process

Coach Ken 1st Quarter Time Out:

- headers/column names
- missing data
- file converter (.xls to .xlsx)
- importing excel workbooks (openpyxl)
- merging multiple sources of data

```python
for FileList in glob.glob('*.xlsx'):
    workbook = load_workbook(filename=FileList)
    #open workbook
    sheet = workbook.active
    #modify the desired cell
    sheet["L2"] = "Y/G_rush"
    sheet["U2"] = "Y/G_receiving"
    sheet["I2"] = "TD_rush"
    sheet["R2"] = "TD_receiving"
    sheet["J2"] = "Lng_rush"
    sheet["S2"] = "Lng_receiving"
    sheet["H2"] = "Yds_rush"
    sheet["P2"] = "Yds_receiving"
    #save the file
    workbook.save(filename=FileList)
```

Browns Rushing & Receiving 2022

No.	Player	Age	Pos	G	GS	Att	Yds_rush	TD_rush	Lng_rush	Y/A	Y/G_rush	A/G	Tgt	Rec	Yds_receiving	Y/R	TD_receiving	Lng_receiving	R/G	Y/G_receiving	Ctch%	Y/Tgt	Touch	Y/Tch	YScm	RRTD	Fmb
24	Nick Chub	27	RB	17	17	302	1525	12	41	5.0	89.7	17.8	37	27	239	8.9	1	26	1.6	14.1	73.0%	6.5	329	5.4	1764	13	1
27	Kareem Hu	27	RB	17	0	123	468	3	24	3.8	27.5	7.2	44	35	210	6.0	1	24	2.1	12.4	79.5%	4.8	158	4.3	678	4	1
7	Jacoby Bri	30	QB	16	11	49	243	2	22	5.0	15.2	3.1			0								49	5.0	243	2	6
4	Deshaun V	27	QB	6	6	36	175	1	21	4.9	29.2	6.0			0								36	4.9	175	1	1
34	Jerome Fo	23	RB	13	0	8	12	0	9	1.5	0.9	0.6			0								8	1.5	12	0	1
10	Anthony S	22	WR	11	1	4	57	1	31	14.3	5.2	0.4	10	4	51	12.8	0	19	0.4	4.6	40.0%	5.1	8	13.5	108	1	1
30	D'Ernest J	26	RB	15	0	4	17	0	7	4.3	1.1	0.3	3	3	7	2.3	0	7	0.2	0.5	100.0%	2.3	7	3.4	24	0	
85	David Njok	26	TE	14	14	2	-8	0	-2	-4.0	-0.6	0.1	80	58	628	10.8	4	38	4.1	44.9	72.5%	7.9	60	10.3	620	4	1
11	Donovan P	23	WR	17	14	1	2	0	2	2.0	0.1	0.1	96	61	839	13.8	3	42	3.6	49.4	63.5%	8.7	62	13.6	841	3	1
88	Harrison B	24	TE	17	9	1	8	0	8	8.0	0.5	0.1	42	31	239	7.7	1	30	1.8	14.1	73.8%	5.7	32	7.7	247	1	
12	Michael W	22	WR	10	0	1	-5	0	-5	-5.0	-0.5	0.1	10	5	45	9.0	0	15	0.5	4.5	50.0%	4.5	6	6.7	40	0	
25	Demetric F	24	RB	8	2	1	-4	0	-4	-4.0	-0.5	0.1	4	2	8	4.0	0	5	0.3	1.0	50.0%	2.0	3	1.3	4	0	1
2	Amari Coo	28	WR	17	17			0					132	78	1160	14.9	9	55	4.6	68.2	59.1%	8.8	78	14.9	1160	9	
18	David Bell	22	WR	16	3			0					35	24	214	8.9	0	20	1.5	13.4	68.6%	6.1	24	8.9	214	0	
84	Pharaoh B	28	TE	13	5			0					10	5	45	9.0	0	11	0.4	3.5	50.0%	4.5	5	9.0	45	0	
17	Daylen Ba	23	WR	1	0			0					2	2	25	12.5	0	15	2.0	25.0	100.0%	12.5	2	12.5	25	0	
78	Jack Conk	28	T	14	14			0					1	0	0		0	0	0.0	0.0	0.0%	0.0				0	
86	Miller Forri	24	TE	4	0			0					1	0	0		0	0	0.0	0.0	0.0%	0.0				0	
	Team Tota	25.5		17		532	2490	19	41	4.7	146.5	31.3	507	335	3710	11.1	19	55	19.7	218.2	66.1%	7.3	867	7.2	6200	38	15
	Opp Total			17		488	2295	22			4.7	135.0	28.7		315	3336	10.6	20		18.5	196.2					5631	42	26

Vikings Rushing & Receiving 2022

No.	Player	Age	Pos	G	GS	Att	Yds_rush	TD_rush	Lng_rush	Y/A	Y/G_rush	A/G	Tgt	Rec	Yds_receiving	Y/R	TD_receiving	Lng_receiving	R/G	Y/G_receiving	Ctch%	Y/Tgt	Touch	Y/Tch	YScm	RRTD	Fmb
4	Dalvin Coo	27	RB	17	17	264	1173	8	81	4.4	69.0	15.5	56	39	295	7.6	2	64	2.3	17.4	69.6%	5.3	303	4.8	1468	10	4
2	Alexander	24	RB	17	0	74	283	5	15	3.8	16.6	4.4	18	15	91	6.1	1	16	0.9	5.4	83.3%	5.1	89	4.2	374	6	
8	Kirk Cousi	34	QB	17	17	31	97	2	19	3.1	5.7	1.8			0								31	3.1	97	2	7
26	Kene Nwai	24	RB	17	0	9	14	0	8	1.6	0.8	0.5	2	2	21	10.5	0	16	0.1	1.2	100.0%	10.5	11	3.2	35	0	
32	Ty Chandle	24	RB	3	0	6	20	0	10	3.3	6.7	2.0			0								6	3.3	20	0	
18	Justin Jeffe	23	WR	17	17	4	24	1	10	6.0	1.4	0.2	184	128	1809	14.1	8	64	7.5	106.4	69.6%	9.8	132	13.9	1833	9	
30	C.J. Ham	29	FB	17	4	4	7	2	3	1.8	0.4	0.2	12	10	86	8.6	0	17	0.6	5.1	83.3%	7.2	14	6.6	93	2	
5	Jalen Reag	23	WR	17	0	4	25	0	17	6.3	1.5	0.2	13	8	104	13.0	1	38	0.5	6.1	61.5%	8.0	12	10.8	129	1	4
12	Nick Mulle	27	QB	4	0	4	8	0	4	2.0	2.0	1.0			0								4	2.0	8	0	
17	K.J. Osbor	25	WR	17	9	3	6	0	5	2.0	0.4	0.2	90	60	650	10.8	5	66	3.5	38.2	66.7%	7.2	63	10.4	656	5	1
19	Adam Thie	32	WR	17	17	1	4	0	4	4.0	0.2	0.1	107	70	716	10.2	6	36	4.1	42.1	65.4%	6.7	71	10.1	720	6	
87	T.J. Hocke	25	TE	10	7			0					86	60	519	8.7	3	21	6.0	51.9	69.8%	6.0	60	8.7	519	3	1
84	Irv Smith J	24	TE	8	1			0					36	25	182	7.3	2	17	3.1	22.8	69.4%	5.1	25	7.3	182	2	1
86	Johnny Mu	28	TE	17	12			0					21	19	140	7.4	1	17	1.1	8.2	90.5%	6.7	19	7.4	140	1	
83	Jalen Naild	23	WR	15	0			0					13	9	179	19.9	1	47	0.6	11.9	69.2%	13.8	9	19.9	179	1	
82	Ben Ellefs	26	TE	4	1			0					3	3	26	8.7	0	12	0.8	6.5	100.0%	8.7	3	8.7	26	0	
	Team Tota	25.9		17		404	1661	18	81	4.1	97.7	23.8	641	448	4818	10.8	30	66	26.4	283.4	69.9%	7.5	852	7.6	6479	48	18
	Opp Total			17		463	2093	18			4.5	123.1	27.2		408	4515	11.1	23		24.0	265.6					6608	41	20

Source: pro-football-reference.com

Positional Spending

2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | **2022** | 2023 | 2024 | 2025 | 2026

Team	QB	RB	WR	TE	OL	Offense	IDL	EDGE	LB	S	CB	Defense
Commanders	$32,853,576	$5,121,964	$28,411,119	$9,657,546	$35,455,377	**$111,499,582**	$20,137,963	$17,081,969	$9,648,261	$6,572,800	$15,391,044	**$68,832,037**
Cowboys	$21,325,834	$20,945,082	$13,438,525	$13,499,164	$41,380,342	**$110,588,947**	$8,309,513	$19,438,110	$11,775,184	$9,347,479	$18,798,262	**$67,668,548**
Chiefs	$38,825,381	$6,354,516	$17,174,008	$11,542,063	$32,124,103	**$106,020,071**	$35,145,929	$21,080,281	$5,261,411	$10,692,255	$5,600,619	**$77,780,495**
Titans	$39,710,700	$11,960,977	$14,123,712	$6,991,640	$29,697,377	**$102,484,406**	$16,401,876	$27,135,472	$8,756,546	$14,150,405	$11,447,369	**$77,891,668**
Jets	$14,312,222	$4,608,666	$25,719,256	$8,380,587	$46,776,978	**$99,797,709**	$20,430,097	$33,306,114	$10,709,069	$8,949,308	$16,520,137	**$89,914,725**
Lions	$32,219,500	$9,162,629	$14,045,393	$2,328,750	$41,941,085	**$99,697,357**	$12,747,744	$28,277,728	$8,275,184	$8,925,370	$18,071,989	**$76,298,015**
Cardinals	$16,348,925	$6,213,758	$24,621,833	$7,121,287	$44,681,251	**$98,987,054**	$23,503,243	$9,842,220	$15,369,345	$19,606,956	$7,124,107	**$75,445,871**
Patriots	$6,453,362	$5,591,629	$35,197,112	$23,907,622	$26,861,818	**$98,011,543**	$18,729,027	$22,426,262	$8,224,132	$17,181,924	$19,990,358	**$86,551,703**
Chargers	$10,283,406	$9,875,576	$37,838,148	$6,820,248	$31,772,859	**$96,590,237**	$13,777,389	$41,335,618	$9,663,825	$13,289,700	$21,839,498	**$99,906,030**
Vikings	$32,714,868	$15,003,672	$20,983,931	$4,284,548	$23,308,381	**$96,295,400**	$15,474,289	$19,943,129	$19,514,329	$12,077,857	$10,659,606	**$77,669,210**
Packers	$32,117,878	$7,807,590	$12,102,936	$9,967,867	$31,221,736	**$93,218,007**	$22,816,924	$18,660,198	$9,700,624	$15,340,635	$15,826,881	**$82,345,262**
Buccaneers	$15,762,231	$7,606,106	$25,649,717	$6,774,488	$36,945,947	**$92,738,489**	$16,245,569	$13,044,679	$26,999,723	$6,991,080	$16,467,478	**$79,748,529**
Broncos	$18,082,500	$6,405,499	$19,436,070	$5,262,023	$43,074,703	**$92,260,795**	$13,772,100	$10,635,344	$6,989,055	$23,249,297	$22,834,821	**$77,480,617**
Ravens	$24,100,655	$8,179,654	$7,616,822	$12,307,075	$38,678,276	**$90,882,482**	$11,195,023	$14,877,531	$7,852,081	$12,066,802	$32,103,215	**$78,094,652**
Jaguars	$11,319,156	$5,232,412	$29,108,793	$16,652,093	$28,354,461	**$90,666,915**	$18,616,330	$29,701,227	$11,848,942	$14,816,692	$28,605,261	**$103,588,452**
Dolphins	$15,532,211	$6,283,012	$22,148,490	$19,623,554	$25,147,971	**$88,735,238**	$22,072,401	$16,107,979	$15,828,692	$10,737,529	$29,180,509	**$93,927,110**
Bengals	$11,332,371	$15,533,810	$22,298,088	$7,324,969	$30,652,020	**$87,141,258**	$25,457,899	$24,666,921	$7,997,820	$26,928,297	$20,293,823	**$105,344,760**
Colts	$22,163,558	$3,818,974	$9,081,436	$9,255,943	$42,356,344	**$86,676,255**	$29,095,351	$22,019,573	$20,698,461	$5,299,201	$21,899,515	**$99,012,101**
Browns	$14,942,928	$14,503,104	$11,614,046	$6,171,535	$37,805,257	**$85,036,870**	$9,433,318	$19,071,235	$9,826,334	$11,808,926	$12,414,924	**$62,554,737**
Giants	$11,387,502	$9,341,218	$33,814,024	$964,500	$29,496,146	**$85,003,390**	$22,368,816	$11,294,138	$3,987,964	$7,641,916	$15,143,232	**$60,436,066**
Saints	$7,103,500	$9,824,543	$25,618,265	$7,923,351	$31,639,451	**$82,109,110**	$11,178,334	$22,420,038	$11,770,496	$11,076,225	$15,450,274	**$71,895,367**
Raiders	$20,418,333	$9,227,435	$19,243,265	$15,179,098	$17,819,365	**$81,887,496**	$8,277,623	$27,221,208	$7,958,161	$4,938,654	$10,529,295	**$58,924,941**
49ers	$22,715,235	$3,134,553	$15,039,393	$10,376,509	$29,524,154	**$80,789,844**	$18,535,038	$25,268,938	$16,541,317	$17,549,904	$14,537,091	**$92,432,288**
Bills	$20,230,481	$7,299,886	$18,982,654	$4,501,683	$29,350,967	**$80,365,671**	$16,458,562	$12,078,022	$24,091,768	$18,151,730	$26,310,989	**$97,091,071**
Panthers	$20,461,726	$3,829,960	$12,882,679	$5,253,310	$33,291,588	**$75,719,263**	$11,405,978	$9,462,303	$23,312,667	$6,802,770	$16,752,502	**$67,736,220**
Rams	$16,649,944	$2,816,993	$28,497,273	$5,474,116	$20,272,409	**$73,710,735**	$42,719,120	$9,516,649	$5,686,025	$6,950,860	$30,915,195	**$95,787,849**
Seahawks	$5,309,222	$9,510,195	$23,912,230	$7,941,161	$23,568,919	**$70,241,727**	$24,351,722	$16,138,952	$10,206,077	$18,131,252	$7,838,060	**$76,666,063**
Eagles	$5,008,230	$5,245,906	$13,659,798	$6,148,811	$37,545,173	**$67,607,918**	$30,816,368	$21,673,435	$6,090,121	$5,344,794	$17,532,680	**$81,457,398**
Texans	$3,856,318	$5,480,218	$16,068,691	$3,710,583	$37,408,894	**$66,524,704**	$7,425,859	$15,929,240	$12,683,243	$9,515,023	$16,819,387	**$62,372,752**
Falcons	$6,303,695	$4,894,510	$9,535,858	$10,678,128	$32,848,444	**$64,260,635**	$18,104,464	$6,077,102	$4,917,321	$4,468,126	$14,033,033	**$47,600,046**
Bears	$6,917,413	$4,900,984	$11,115,639	$5,756,091	$27,473,483	**$56,163,610**	$11,799,311	$5,649,095	$6,862,834	$20,336,001	$5,518,865	**$50,166,106**
Steelers	$10,257,801	$5,678,067	$15,219,777	$3,360,462	$18,038,971	**$52,555,078**	$35,843,671	$27,954,767	$16,767,187	$13,290,212	$16,048,278	**$109,904,115**

Source:
overthecap.com

Master Scheme

|	Team	QB	RB	WR	TE	OL	Offense	IDL	EDGE	LB	...	L	T	Div. Finish	Playoffs	PF	PA	PD	Pts	Yds	Wins/RB_Spending
0	Cowboys	21325834	20945082	13438525	13499164	41380342	110588947	8309513	19438110	11775184	...	5	0	2nd of 4	Lost Divisional Round	467	342	125	4	11	0.000001
1	Vikings	5245038	16960950	15700531	8705993	29660487	76272999	10108617	15465984	11870684	...	5	0	1st of 4	Lost Wild Card Round	365	302	63	16	29	0.000001
2	Eagles	3772237	16415834	10693053	5720045	29339566	65940735	6088275	17791018	10285319	...	6	0	2nd of 4	Did Not Make Playoffs	474	400	74	3	5	0.000001
3	Texans	14334715	16353897	23107507	6027564	37592815	97416498	23019923	16478521	17873795	...	12	0	3rd of 4	Did Not Make Playoffs	384	464	-80	18	13	0.0
4	Vikings	8470554	15752460	10378281	4582245	20329032	59512572	11556066	24552100	13577945	...	10	1	4th of 4	Did Not Make Playoffs	391	480	-89	14	13	0.0
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
315	Steelers	27991392	1766913	4570576	8105668	36091768	78526317	31563825	14409336	13056501	...	8	0	2nd of 4	Did Not Make Playoffs	289	303	-14	27	30	0.000005
316	Steelers	21333138	1669039	7942649	7847766	14731514	53524106	9360367	13428435	15222160	...	5	0	1st of 4	Lost Wild Card Round	436	368	68	7	2	0.000007
317	Packers	22071928	1581868	26709607	10835666	33058976	94258045	19391088	23692894	4603006	...	9	1	3rd of 4	Did Not Make Playoffs	376	400	-24	14	12	0.000004
318	Steelers	24607847	1545560	13094252	5891394	35090781	80229834	18570996	7627086	15162163	...	6	1	2nd of 4	Did Not Make Playoffs	428	360	68	6	4	0.000006
319	Browns	2807980	1529301	10771737	4683350	30648671	50441039	17269848	13935899	7257125	...	9	0	4th of 4	Did Not Make Playoffs	299	337	-38	27	23	0.000005

Offensive Play Calling:

- Visualizations of the Pandas dataframe
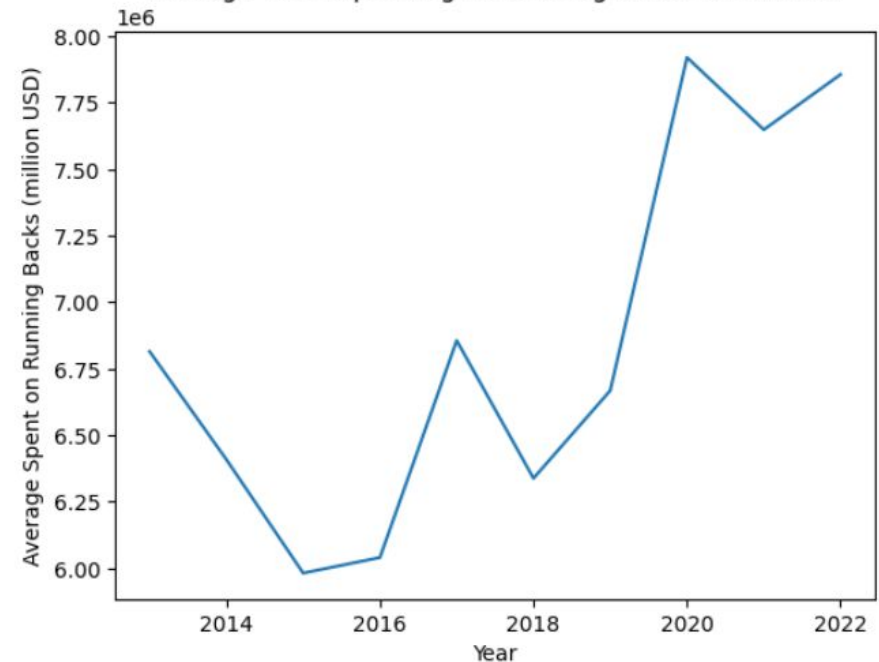- Linear regressions in R

Verizon Halftime Show

Total Rushing+Receiving Yards by Running Backs Over the Last 10 Seasons
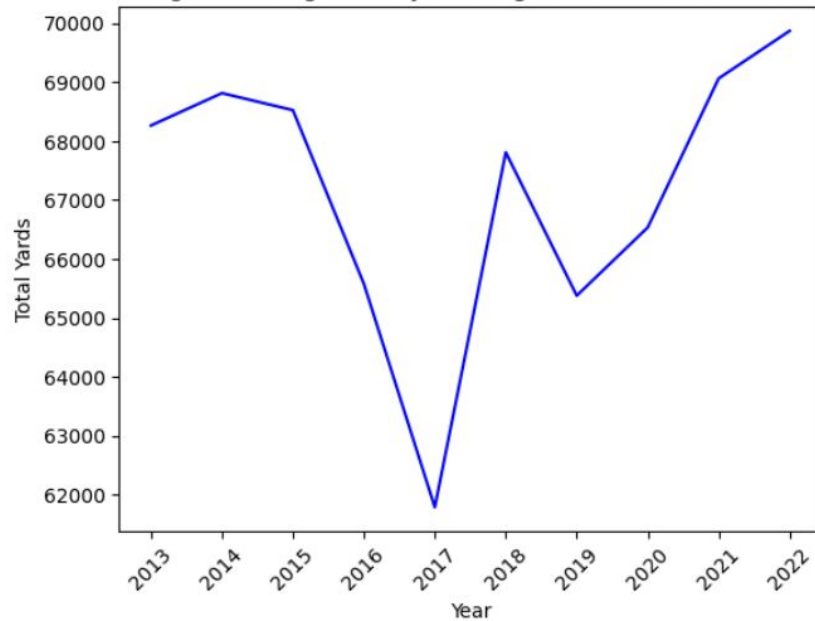
Average Team Spending on Running Backs Per Season

End State: Primary focus on computation and exploring new ways to visualize the data

3rd Quarter:

$$\widehat{Wins} = 4.38 + (6.32 * 10^{-8}) * RB$$
$$+ (1.12 * 10^{-8}) * WR$$
$$+ (6.74 * 10^{-8}) * TE$$
$$+ (4.50 * 10^{-8}) * QB$$
$$+ (-2.04 * 10^{-8}) * OL$$
$$+ (3.54 * 10^{-8}) * Defense$$

```
Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)  4.381e+00  9.380e-01   4.670 4.47e-06 ***
RB           6.319e-08  4.953e-08   1.276  0.20291
WR           1.120e-08  2.525e-08   0.444  0.65769
TE           6.742e-08  4.546e-08   1.483  0.13906
QB           4.499e-08  1.991e-08   2.260  0.02453 *
OL          -2.037e-08  2.069e-08  -0.984  0.32573
Defense      3.542e-08  1.179e-08   3.005  0.00287 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Final Whistle
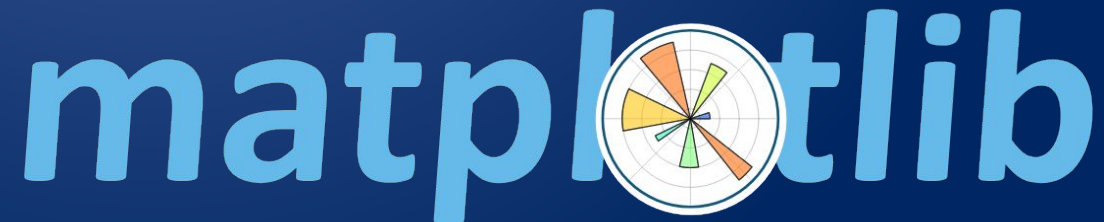
Berman's Fastest Three Minutes In Sports:

- Spending more on running backs does not guarantee more wins
- Due to the salary cap, there has to be a tradeoff
- Running backs are not as valuable as they say, despite flashy numbers

Future Prospects

-Does defense really win championships?

- Additional computational methods: More efficient data collection through fuzzy matching, web scraping and API calls

-Enhanced Visualization: plots with customized icons

- More in-depth exploration of individual player level data

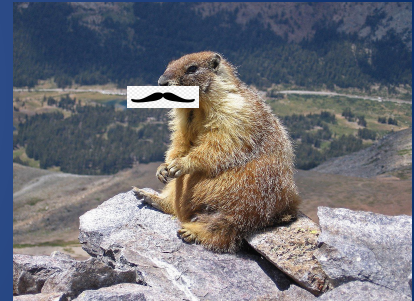-Research Allocation of a team's budget in a given year for all positions

Press Conference

Head Coach: Giovanni 'Coach Prime' Macaluso
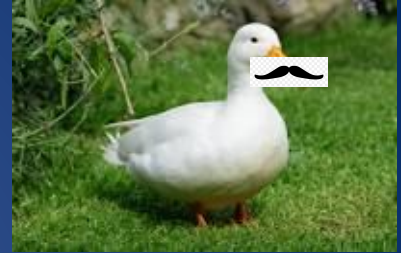
Offensive Coordinator: Rocco 'Belichick' Patel

Defensive Coordinator: Katie 'Sauce' Livingston