

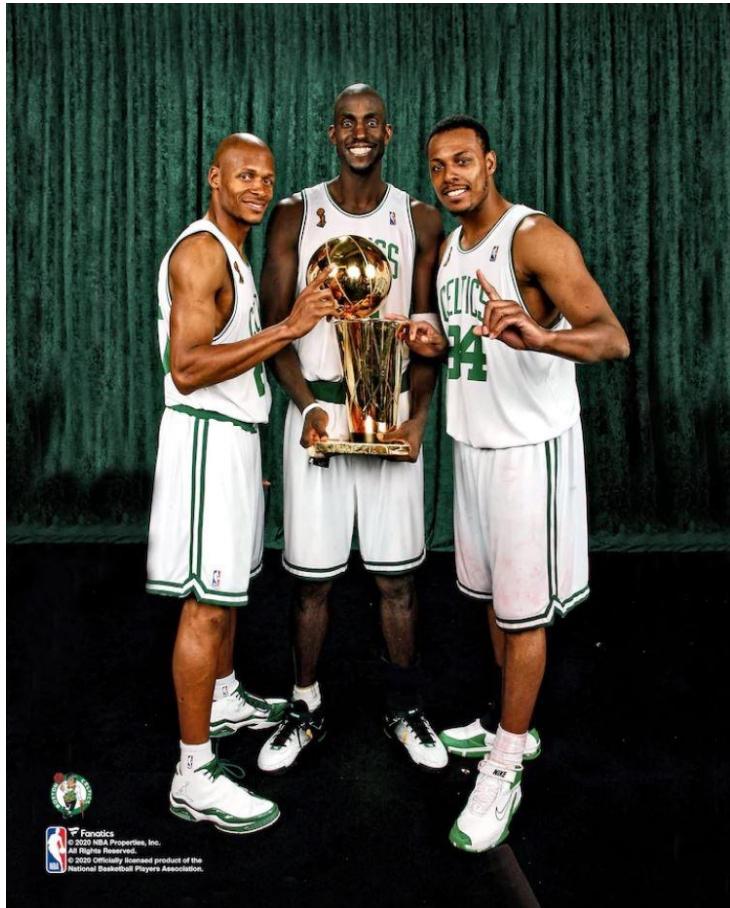
NBA Free Agent Salary Predictor



Metis Regression Module Presentation

Andrei Levin • 7/9/21

The Celtics Have a Storied History...



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Boston Celtics

From Wikipedia, the free encyclopedia

"Celtics" redirects here. For other uses, see [Celtic](#).

The **Boston Celtics** (/səltɪks/ *SEL-tiks*) are an American professional basketball team based in [Boston](#). The Celtics compete in the [National Basketball Association](#) (NBA) as a member of the league's [Eastern Conference Atlantic Division](#). Founded in 1946 as one of the league's original eight teams, the Celtics play their home games at [TD Garden](#), which they share with the [National Hockey League's Boston Bruins](#). The Celtics are regarded as one of the most successful basketball teams in NBA history; the franchise is tied with the [Los Angeles Lakers](#) for most NBA Championships won with 17 (accounting for 23.6 percent of all NBA championships since the league's founding) and currently holds the record for the most recorded wins of any NBA team.^{[10][11]} The Celtics are one of the two charter BAA franchises (the other is the [New York Knicks](#)) still playing in their original city.

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...But Have Lately Fallen on Harder Times



...But Have Lately Fallen on Harder Times

US NBA OCTOBER 11, 2020 / 10:23 PM / UPDATED 9 MONTHS AGO

Lakers beat Heat to win NBA championship



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NETS 123, CELTICS 109

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By [Adam Himmelsbach](#) Globe Staff,
Updated June 1, 2021, 10:09 p.m.



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Danny Ainge Retires As Celtics' President Of Basketball Operations

June 2, 2021 at 9:31 am

Filed Under: [Adrian Wojnarowski](#), [Boston Celtics](#), [Danny Ainge](#), [nba](#), [Sports News](#)

Research Question

- Can we predict an NBA Free Agent's salary from his previous season stats and salary?

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 BASKETBALL
REFERENCE

Enter Person, Team, Section, etc

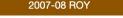
Kevin Durant

Kevin Wayne Durant • Twitter: [KD'Trey5](#)
(Durantula, KD, Slim Reaper, Easy Money Sniper, The Servant, Green Room)
Position: Small Forward, Power Forward, and Shooting Guard • Shoots: Right
6-10, 240lb (208cm, 108kg)
Born: [September 29, 1988](#) (Age: 32-283d) in Washington, [District of Columbia](#) 
College: [Texas](#)
High School: Montrose Christian School in Rockville, [Maryland](#)
Recruiting Rank: [2006](#) (2)
Draft: [Seattle SuperSonics](#), 1st round (2nd pick, 2nd overall), [2007 NBA Draft](#)
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Experience: 12 years

11x All Star 4x Scoring Champ 2x NBA Champ 9x All-NBA

2007-08 All-Rookie 2x AS MVP 2x Finals MVP 2013-14 MVP

2007-08 ROY



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11x All Star	4x Scoring Champ	2x NBA Champ	9x All-NBA
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Per Game

Bold indicates league leader Share & Export ▾ Glossary

Regular Season

Playoffs

Season	Age	Team	Lg	Pos	G	GS	MP	FG	FGA	FG%	3P	3PA	3P%	2P	2PA	2P%	eFG%	FT	FTA	FT%	ORB	DRB	TRB	AST	STL	BLK	TOV	PF	PTS
2007-08	19	SEA	NBA	SG	80	80	34.6	7.3	17.1	.430	0.7	2.6	.288	6.6	14.5	.455	.451	4.9	5.6	.873	0.9	3.5	4.4	2.4	1.0	0.9	2.9	1.5	20.3
2008-09	20	OKC	NBA	SF	74	74	39.0	8.9	18.8	.476	1.3	3.1	.422	7.6	15.7	.486	.510	6.1	7.1	.863	1.0	5.5	6.5	2.8	1.3	0.7	3.0	1.8	25.3
2009-10	21	OKC	NBA	SF	82	82	39.5	9.7	20.3	.476	1.6	4.3	.365	8.1	16.1	.506	.514	9.2	10.2	.900	1.3	6.3	7.6	2.8	1.4	1.0	3.3	2.1	30.1
2010-11	22	OKC	NBA	SF	78	78	38.9	9.1	19.7	.462	1.9	5.3	.350	7.3	14.4	.504	.509	7.6	8.7	.880	0.7	6.1	6.8	2.7	1.1	1.0	2.8	2.0	27.7
2011-12	23	OKC	NBA	SF	66	66	38.6	9.7	19.7	.496	2.0	5.2	.387	7.7	14.4	.535	.547	6.5	7.6	.860	0.6	7.4	8.0	3.5	1.3	1.2	3.8	2.0	28.0
2012-13	24	OKC	NBA	SF	81	81	38.5	9.0	17.7	.510	1.7	4.1	.416	7.3	13.6	.539	.559	8.4	9.3	.905	0.6	7.3	7.9	4.6	1.4	1.3	3.5	1.8	28.1
2013-14	25	OKC	NBA	SF	81	81	38.5	10.5	20.8	.503	2.4	6.1	.391	8.1	14.8	.549	.560	8.7	9.9	.873	0.7	6.7	7.4	5.5	1.3	0.7	3.5	2.1	32.0
2014-15	26	OKC	NBA	SF	27	27	33.8	8.8	17.3	.510	2.4	5.9	.403	6.4	11.4	.565	.578	5.4	6.3	.854	0.6	6.0	6.6	4.1	0.9	0.7	2.7	1.5	25.4
2015-16	27	OKC	NBA	SF	72	72	35.8	9.7	19.2	.505	2.6	6.7	.387	7.1	12.5	.569	.573	6.2	6.9	.898	0.6	7.0	8.2	5.0	1.0	1.2	3.5	1.9	28.2
2016-17	28	GSW	NBA	PF	62	62	33.4	8.9	16.5	.537	1.9	5.0	.375	7.0	11.5	.608	.594	5.4	6.2	.875	0.6	7.6	8.3	4.8	1.1	1.6	2.2	1.9	25.1
2017-18	29	GSW	NBA	SF	68	68	34.2	9.3	18.0	.516	2.5	6.1	.419	6.7	11.9	.555	.586	5.3	5.9	.889	0.5	6.4	6.8	5.4	0.7	1.8	3.0	2.0	26.4
2018-19	30	GSW	NBA	SF	78	78	34.6	9.2	17.7	.521	1.8	5.0	.353	7.5	12.8	.587	.571	5.7	6.5	.885	0.4	5.9	6.4	5.9	0.7	1.1	2.9	2.0	26.0
2019-20	31	Did Not Play (injury—achilles)																											
2020-21	32	BRK	NBA	PF	35	32	33.1	9.3	17.2	.537	2.4	5.4	.450	6.8	11.8	.577	.608	6.0	6.8	.882	0.4	6.7	7.1	5.6	0.7	1.3	3.4	2.0	26.9
Career			NBA		884	881	36.7	9.2	18.6	.494	1.9	4.9	.384	7.3	13.7	.534	.545	6.7	7.6	.883	0.7	6.3	7.1	4.2	1.1	1.1	3.1	1.9	27.0

PAST SALARIES

SEASON	TEAM	SALARY
2019/20	Brooklyn Nets	\$37,199,000 (\$37,439,206*)
2018/19	Golden State Warriors	\$30,000,000 (\$30,691,458*)
2017/18	Golden State Warriors	\$25,000,000 (\$26,310,648*)
2016/17	Golden State Warriors	\$26,540,100 (\$28,387,747*)
2015/16	Oklahoma City Thunder	\$21,971,850 (\$23,735,855*)
2014/15	Oklahoma City Thunder	\$19,997,513 (\$21,629,747*)
2013/14	Oklahoma City Thunder	\$18,773,176 (\$20,726,276*)
2012/13	Oklahoma City Thunder	\$17,548,838 (\$19,714,472*)
2011/12	Oklahoma City Thunder	\$15,506,632 (\$17,710,117*)
2010/11	Oklahoma City Thunder	\$10,563,663 (\$7,159,939*)
2009/10	Oklahoma City Thunder	\$4,796,880 (\$5,733,247*)
2008/09	Oklahoma City Thunder	\$4,484,040 (\$5,282,873*)
2007/08	Oklahoma City Thunder	\$4,171,200 (\$5,161,087*)
Total		\$232,042,892 (\$249,682,672*)

Advanced

Bold indicates league leader Share & Export ▾ Glossary

Regular Season

Playoffs

Season	Age	Team	Lg	Pos	G	MP	PER	TS%	3PAr	FTr	ORB%	DRB%	TRB%	AST%	STL%	BLK%	TOV%	USG%	OWS	DWS	WS	WS/48	OBPM	DBPM	BPM	VORP
2007-08	19	SEA	NBA	SG	2768	15.8	.519	.150	.328	2.8	10.9	6.9	12.0	1.4	1.9	12.9	28.1	0.4	1.9	2.3	.040	0.5	-0.7	-0.1	1.3	
2008-09	20	OKC	NBA	SF	2885	20.8	.577	.165	.377	3.0	16.4	9.6	13.5	1.7	1.4	12.2	28.3	5.2	2.7	7.9	.132	3.4	-0.1	3.3	3.8	
2009-10	21	OKC	NBA	SF	82	3239	26.2	.607	.210	.504	3.8	17.9	11.0	13.5	1.8	1.9	11.7	32.0	11.1	5.0	16.1	.238	6.3	0.8	7.1	7.5
2010-11	22	OKC	NBA	SF	3038	23.6	.589	.269	.439	2.3	17.7	10.3	13.2	1.5	1.8	10.6	30.6	8.6	3.3	12.0	.189	5.2	-0.3	4.9	5.3	
2011-12	23	OKC	NBA	SF	66	2546	26.2	.610	.265	.386	1.9	20.4	11.8	17.5	1.8	2.2	14.0	31.3	8.5	3.7	12.2	.230	6.2	0.8	7.0	5.8
2012-13	24	OKC	NBA	SF	81	3119	28.3	.647	.233	.523	1.8	20.3	11.8	21.7	1.9	2.6	13.7	29.8	13.6	5.3	18.9	.291	7.6	1.7	9.3	8.9
2013-14	25	OKC	NBA	SF	81	3122	29.6	.635	.291	.477	2.2	18.6	10.8	26.7	1.7	1.5	12.2	33.0	14.8	4.4	19.2	.295	8.8	1.4	10.2	9.6
2014-15	26	OKC	NBA	SF	27	913	27.6	.633	.340	.366	1.9	18.7	10.4	22.2	1.3	2.2	12.0	29.1	3.8	1.0	4.8	.252	8.6	1.4	10.0	2.8
2015-16	27	OKC	NBA	SF	72	2578	28.2	.634	.348	.361	2.0	21.8	12.4	24.2	1.3	2.5	13.5	30.6	11.0	3.5	14.5	.270	8.4	1.6	9.9	7.8
2016-17	28	GSW	NBA	PF	62	2070	27.6	.651	.304	.374	2.2	23.6	13.6	23.1	1.5	3.8	10.4	27.8	8.0	4.0	12.0	.278	6.7	2.2	8.9	5.7
2017-18	29	GSW	NBA	SF	68	2325	26.0	.640	.338	.331	1.6	19.5	11.2	25.5	1.0	4.0	12.9	30.4	7.5	2.9	10.4	.215	6.7	0.6	7.3	5.5
2018-19	30	GSW	NBA	SF	78	2702	24.2	.631	.281	.366	1.4	17.5	9.8	26.2	1.0	2.6	12.3	29.0	8.6	2.9	11.5	.204	5.4	0.1	5.5	5.1
2020-21	32	BRK	NBA	PF	35	1157	26.4	.666	.313	.395	1.3	21.3	11.8	27.5	1.0	3.4	14.5	31.2	3.7	1.2	5.0	.206	6.2	0.6	6.9	2.6
Career			NBA		884	32462	25.2	.615	.262	.410	2.3	18.6	10.8	19.8	1.5	2.3	12.5	30.2	104.7	42.0	146.7	.217	6.0	0.7	6.7	7.1

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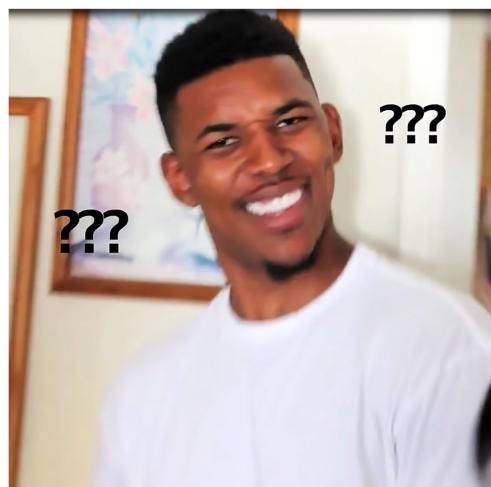
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2007-08 All-Rookie	2x AS MVP	2x Finals
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Per Game

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Season	Age	Team	Lg	Pos	G	GS	MP	FG	FGA	FG%	3P	3PA	3P%	2P	2PA	2P%	eFG%	FT	FTA	FT%	ORB	DRB	TRB	AST	STL	BLK	TOV	PF	PTS
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							38.5	10.5	20.8	.503	2.4	6.1	.391	8.1	14.8	.549	.560	8.7	9.9	.873	0.7	6.7	7.4	5.5	1.3	0.7	3.5	2.1	32.0
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							35.8	9.7	19.2	.505	2.6	6.7	.387	7.1	12.5	.569	.573	6.2	6.9	.898	0.6	7.6	8.2	5.0	1.0	1.2	3.5	1.9	28.2
							33.4	8.9	16.5	.537	1.9	5.0	.375	7.0	11.5	.608	.594	5.4	6.2	.875	0.6	7.6	8.3	4.8	1.1	1.6	2.2	1.9	25.1
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PAST SALARIES	
SEASON	TEAM
2019/20	Brooklyn Nets
2018/19	Golden State Warriors
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2014/15	Oklahoma City Thunder
2013/14	Oklahoma City Thunder
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2768	15.8	.519	.150	.328	2.8	10.9	6.9	12.0	1.4	1.9	12.9	28.1	0.4	1.9	2.3	.040	0.5	-0.7	-0.1	1.3			
2885	20.8	.577	.165	.377	3.0	16.4	9.6	13.5	1.7	1.4	12.2	28.3	5.2	2.7	7.9	.132	3.4	-0.1	3.3	3.8			
3239	26.2	.607	.210	.504	3.8	17.9	11.0	13.5	1.8	1.9	11.7	32.0	11.1	5.0	16.1	.238	6.3	0.8	7.1	7.5			
3038	23.6	.589	.269	.439	2.3	17.7	10.3	13.2	1.5	1.8	10.6	30.6	8.6	3.3	12.0	.189	5.2	-0.3	4.9	5.3			
2546	26.2	6.10	.265	.386	1.9	20.4	11.8	17.5	1.8	2.2	14.0	31.3	8.5	3.7	12.2	.230	6.2	0.8	7.0	5.8			
3119	28.3	.647	.233	.523	1.8	20.3	11.8	21.7	1.9	2.6	13.7	29.8	13.6	5.3	18.9	.291	7.6	1.7	9.3	8.9			
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2016-17 *	28	GSW	NBA	PF	62	2070	27.6	.651	.304	.374	2.2	23.6	13.6	21.1	1.5	3.8	10.4	27.8	8.0	4.0	12.0	.378	
2017-18 *	29	GSW	NBA	SF	68	2325	26.0	.640	.338	.331	1.6	19.5	11.2	25.5	1.0	4.0	12.9	30.4	7.5	2.9	10.4	.215	
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S

Scraping Workflow

The screenshot shows the Basketball Reference website with a green header bar. The main content area has a white background. At the top left is the Basketball Reference logo. To its right is a search bar with the placeholder "Enter Person, Team, Section, etc". Below the search bar is a navigation menu with links: Players, Teams, Seasons, Leaders, Scores, Playoffs, Draft, Stathead, Newsletter, and Full Site Menu Below ▾. A pink oval highlights the "2019 Free Agent Tracker" section title. Below it, the text "287 Free Agents" is followed by "Share & Export ▾" and "Glossary". The main content is a table with the following columns: Rk, Player, Pos, Age, Type, OTm, 2018-19 Stats, WS, NTm, Terms, and Notes. The table lists 7 players:

Rk	Player	Pos	Age	Type	OTm	2018-19 Stats	WS	NTm	Terms	Notes
1	Kevin Durant	F-G	32-283	UFA	GSW	26.0 Pts, 6.4 Reb, 5.9 Ast	11.5	BRK	Signed 4-yr \$164.25M contract with GSW as part of sign-and-trade	
2	Nikola Vučević	C	30-258	UFA	ORL	20.8 Pts, 12.0 Reb, 3.8 Ast	10.1	ORL	Signed 4-yr \$100M contract	
3	Kawhi Leonard	F	30-010	UFA	TOR	26.6 Pts, 7.3 Reb, 3.3 Ast	9.5	LAC	Signed 3-yr \$103.13M contract	
4	Kyrie Irving	G	29-108	UFA	BOS	23.8 Pts, 5.0 Reb, 6.9 Ast	9.1	BRK	Signed 4-yr \$136.49M contract	
5	Jimmy Butler	F-G	31-298	UFA	PHI	18.7 Pts, 5.3 Reb, 4.0 Ast	7.9	MIA	Signed 4-yr \$140.79M contract with PHI as part of sign-and-trade	
6	Al Horford	C-F	35-036	UFA	BOS	13.6 Pts, 6.7 Reb, 4.2 Ast	7.5	PHI	Signed 4-yr \$109M contract	
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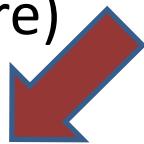
Scraping Workflow

Prev Year
Salary
(Feature)

2019 Free Agent Tracker

287 Free Agents Share & Export ▾ Glossary

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Prev Year Stats (Features)

2018/19 NBA Player Salaries

GO IN-DEPTH

- Salaries of players right now
- Salaries of players back in the day
- Ranking agents by wages
- Upcoming free agents
- All NBA awards in history
- NBA 2K ratings
- Re-ordering draft classes
- TV ratings
- Listen to our podcast
- Follow us on Instagram

SHARE TWEET EMAIL

TEAM PAYROLLS PLAYER SALARIES

2018/19

PLAYER	2018/19	2018/19(*)
1. Stephen Curry	\$37,457,154	\$38,320,489
2. Russell Westbrook	\$35,666,000	\$36,487,029
3. LeBron James	\$35,654,150	\$36,475,929
3. Chris Paul	\$35,654,150	\$36,475,929

Enter Person, Team, Section, etc

Kevin Durant

Kevin Wayne Durant • Twitter: KDtrey5

(Durantula, KD, Slim Reaper, Easy Money Sniper, The Servant, Green Room)
Position: Small Forward, Power Forward, and Shooting Guard • Shoots: Right
6-10, 240lb (208cm, 108kg)
Born: September 29, 1988 (Age: 32-283d) in Washington, District of Columbia USA
College: Texas
High School: Montrose Christian School in Rockville, Maryland
Recruiting Rank: 2006 (2)
Draft: Seattle SuperSonics, 1st round (2nd pick, 2nd overall), 2007 NBA Draft
NBA Debut: October 31, 2007
Experience: 12 years

Scraping Workflow

Prev Year
Salary
(Feature)

2019 Free Agent Tracker

287 Free Agents Share & Export ▾ Glossary

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Next Year
Salary
(Target)

Prev Year Stats (Features)

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PLAYER SALARIES

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NBA Debut: [October 31, 2007](#)

Experience: 12 years

2019/20 NBA Player Salaries

GO IN-DEPTH

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PLAYER SALARIES

2019/20

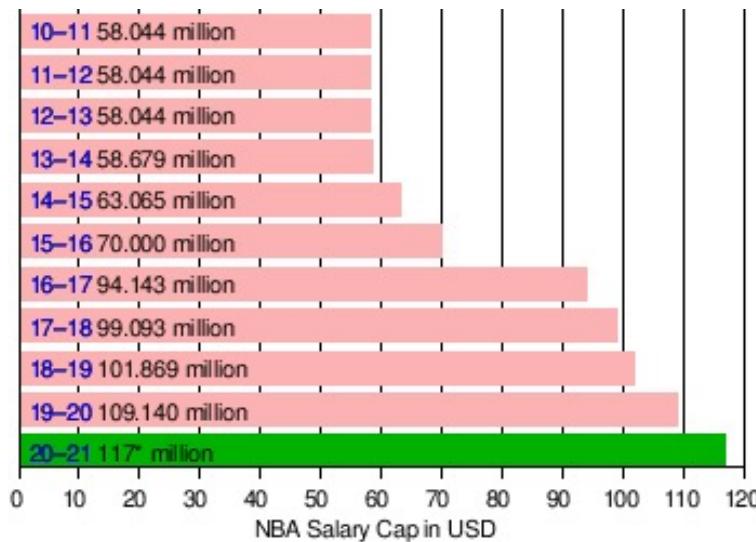
PLAYER	2019/20	2019/20(*)
1. Stephen Curry	\$40,231,758	\$40,491,547
2. Chris Paul	\$38,506,482	\$38,755,131
2. Russell Westbrook	\$38,506,482	\$38,755,131
4. John Wall	\$38,199,000	\$38,445,683

Data Cleaning

- Removed players who didn't play previous year or next year

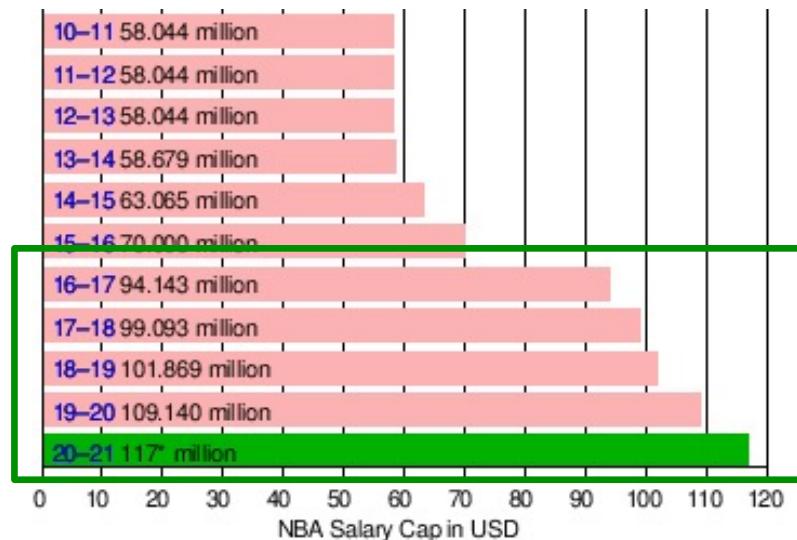
Data Cleaning

- Removed players who didn't play previous year or next year
- Normalized salaries to 2020 salary cap



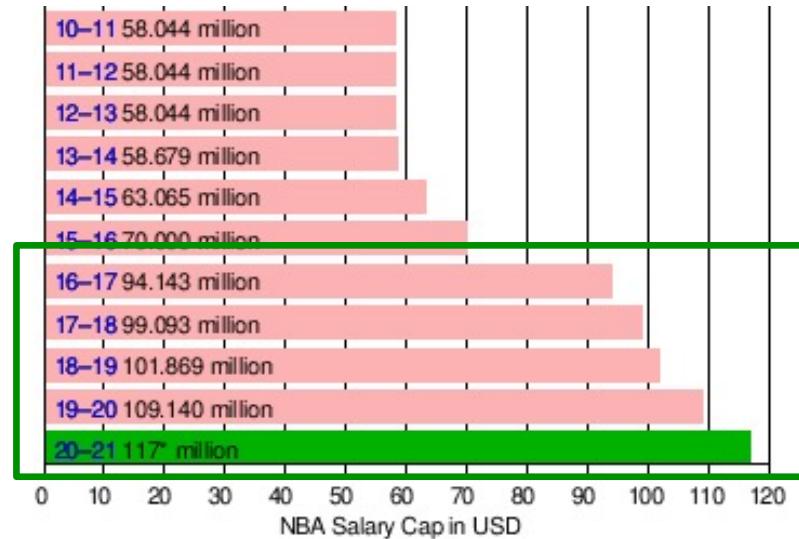
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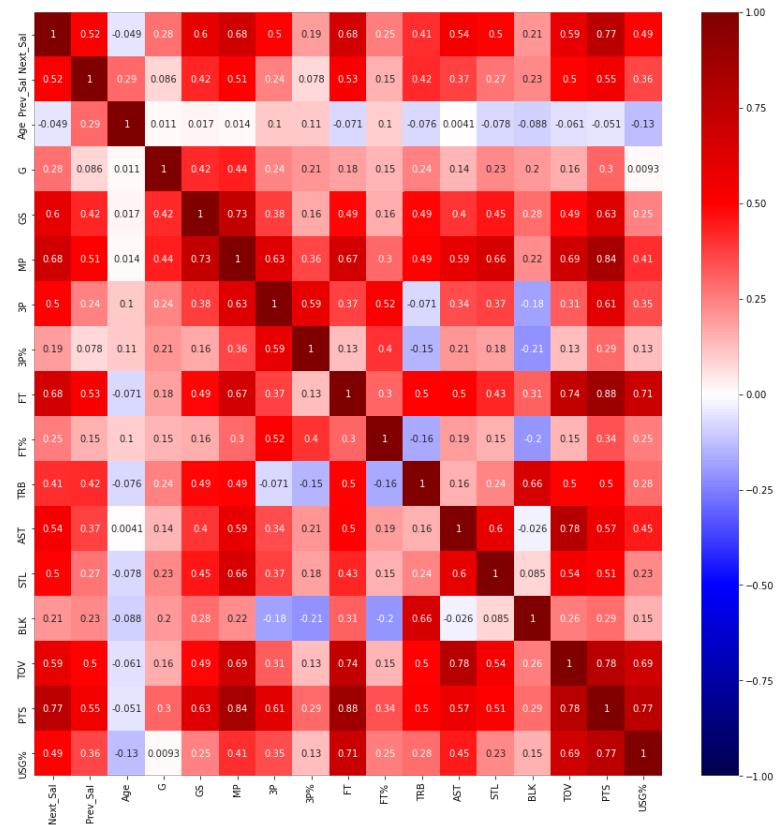
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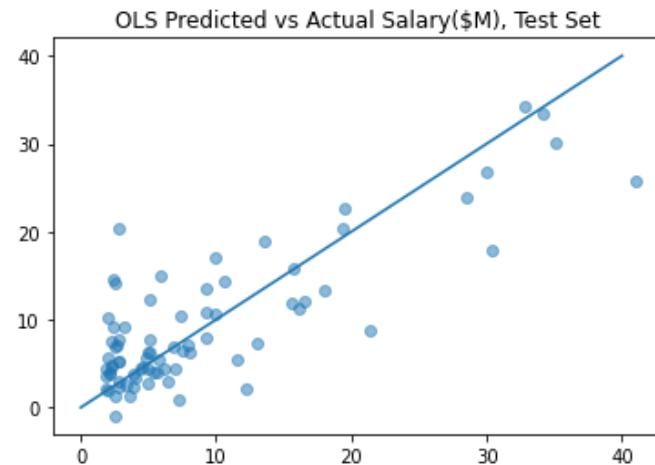
- Final Table: 381 rows, ~30 features

Feature Engineering

- Looked at **correlation matrix**, **p-values**, and **pair plots** for inspiration
- Removed several unimportant features
- Added polynomial terms:
 - (Minutes per game)²
 - (Points per game)²
 - (3-pt %age)*(3-pt per game)
- Added ratio terms:
 - Games Started/Played
 - Turnovers/Assists
- High multicollinearity present (from **condition number**)



Model 1: Cross-Validated OLS

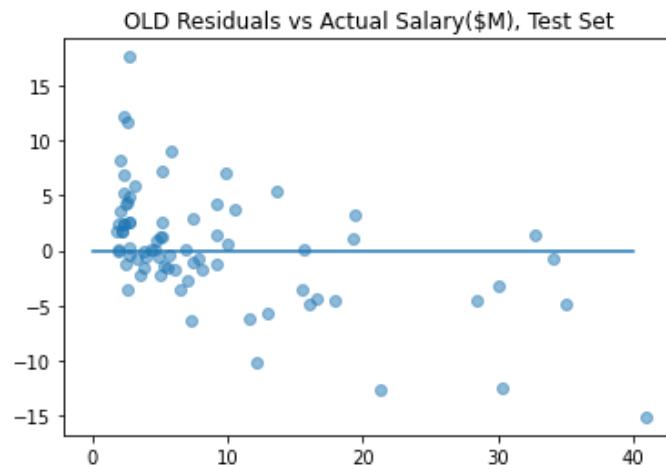


OLS R2 Train 0.736610775968946

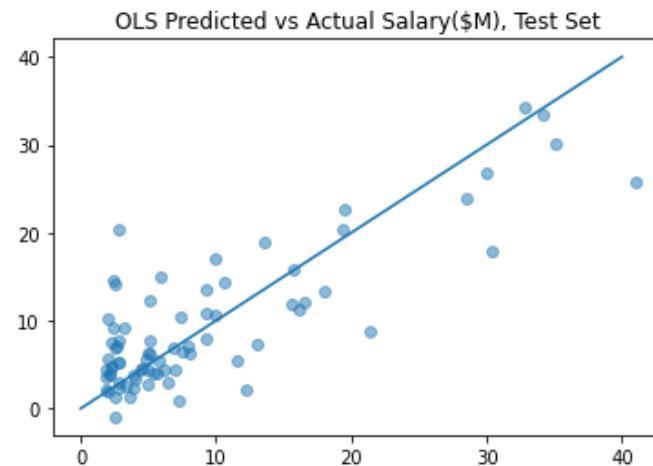
OLS R2 Test 0.6648322578341601

OLS MAE Test 3.710527757807454 (\$M)

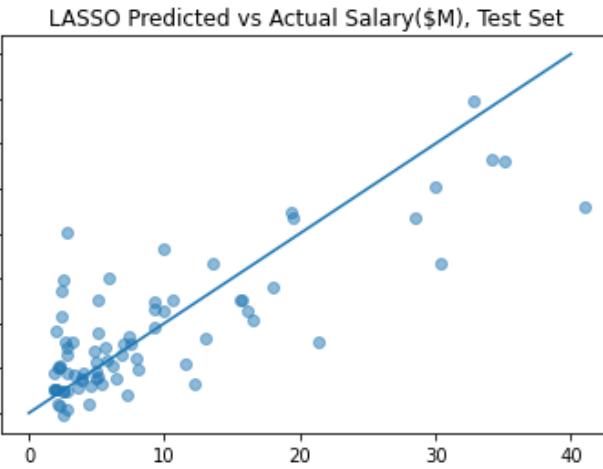
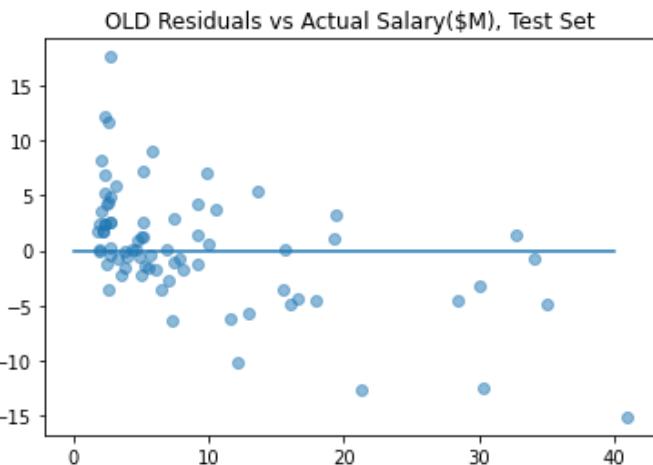
OLS RMSE Test 5.2519191522377735 (\$M)



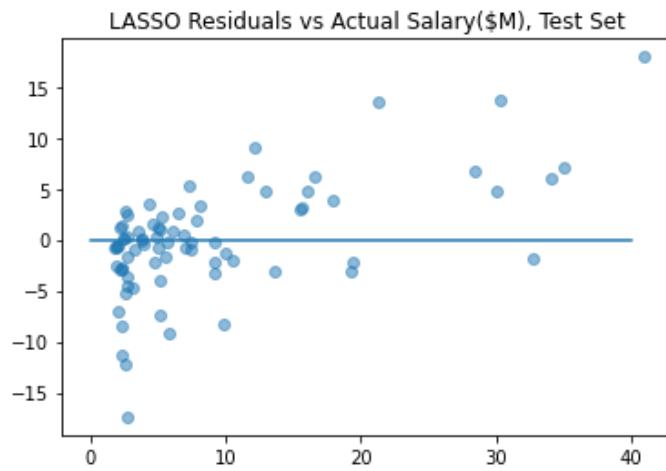
Model 2: Cross-Val Regularized LASSO



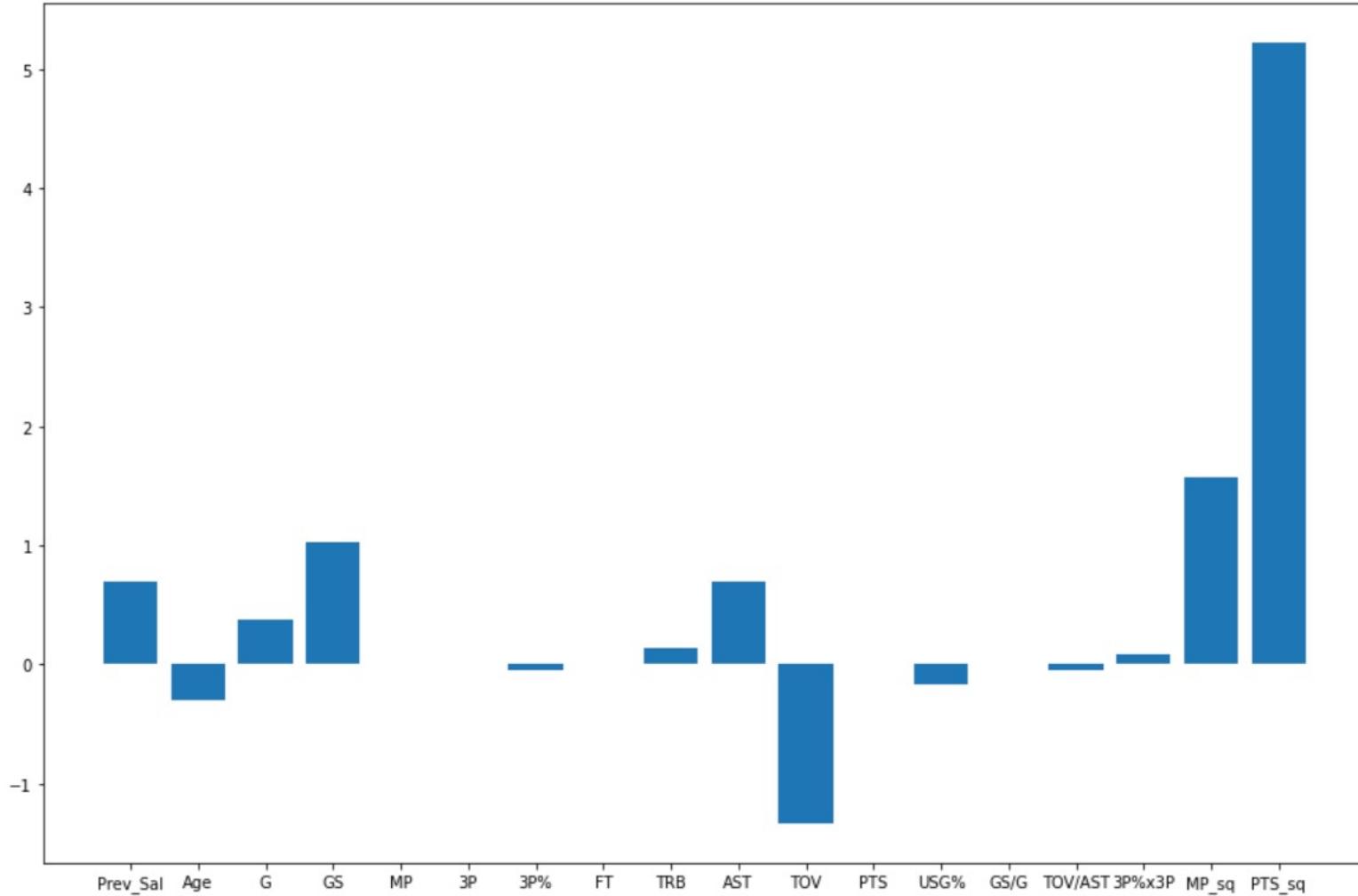
OLS MAE Test 3.710527757807454 (\$M)
OLS RMSE Test 5.2519191522377735 (\$M)



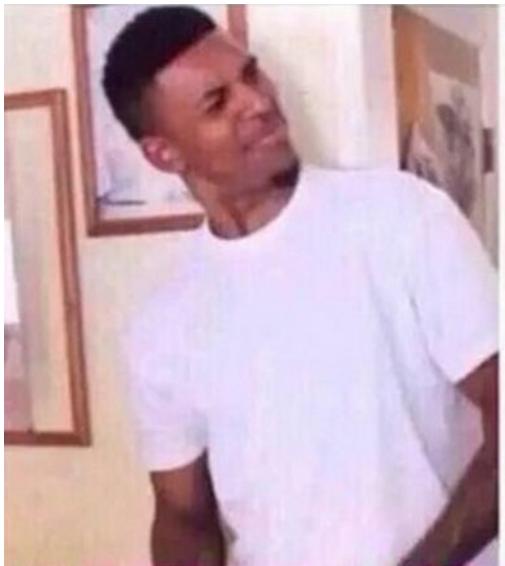
LASSO MAE Test 3.7738943842347004 (\$M)
LASSO RMSE Test 5.438523561429468 (\$M)



LASSO Coefficients



Musings



Potential Pitfalls

- Lack of injury history info
- Lack of multi-year history info
- Lack of playoff stats
- Max and min salary rules

Further Study

- Add “Position” category, study interaction with height, 3P%, etc.
- Age vs. experience; Draft pick status
- Is “betting on yourself” a good strategy?



Key LASSO Takeaway

