

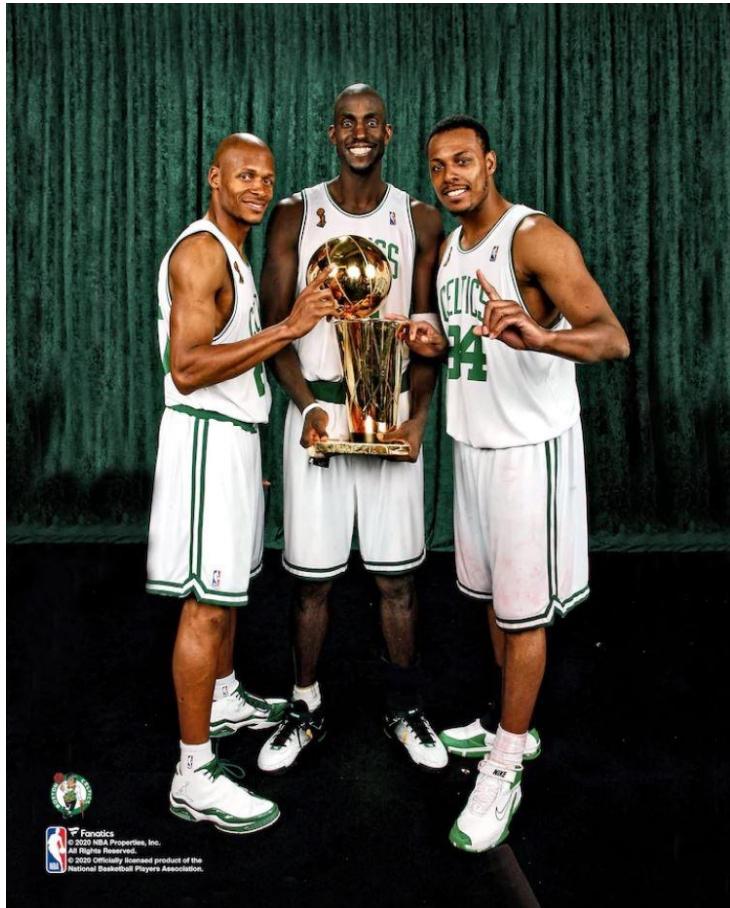
# NBA Free Agent Salary Predictor



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.<sup>[10][11]</sup> 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

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

## Lakers beat Heat to win NBA championship

NETS 123, CELTICS 109

**Celtics lose to Nets, bow out of playoffs, and enter an offseason filled with questions**

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



WBZ CBS Boston

≡ MENU NEWS WEATHER

CBSN Boston  
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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?

 BASKETBALL  
REFERENCE

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



## 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	<b>82</b>	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	<b>30.1</b>
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	<b>27.7</b>
2011-12	23	OKC	NBA	SF	<b>66</b>	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	<b>28.0</b>
2012-13	24	OKC	NBA	SF	<b>81</b>	<b>81</b>	38.5	9.0	17.7	.510	1.7	4.1	.416	7.3	13.6	.539	.559	8.4	9.3	<b>.905</b>	0.6	7.3	7.9	4.6	1.4	1.3	3.5	1.8	<b>28.1</b>
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	<b>32.0</b>
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)	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
2020-21	32	BRK	NBA	PF	<b>884</b>	<b>881</b>	<b>36.7</b>	<b>9.2</b>	<b>18.6</b>	<b>.494</b>	<b>1.9</b>	<b>4.9</b>	<b>.384</b>	<b>7.3</b>	<b>13.7</b>	<b>.534</b>	<b>.545</b>	<b>6.7</b>	<b>7.6</b>	<b>.883</b>	<b>0.7</b>	<b>6.3</b>	<b>7.1</b>	<b>4.2</b>	<b>1.1</b>	<b>1.1</b>	<b>3.1</b>	<b>1.9</b>	<b>27.0</b>
Career		NBA			<b>884</b>	<b>881</b>	<b>36.7</b>	<b>9.2</b>	<b>18.6</b>	<b>.494</b>	<b>1.9</b>	<b>4.9</b>	<b>.384</b>	<b>7.3</b>	<b>13.7</b>	<b>.534</b>	<b>.545</b>	<b>6.7</b>	<b>7.6</b>	<b>.883</b>	<b>0.7</b>	<b>6.3</b>	<b>7.1</b>	<b>4.2</b>	<b>1.1</b>	<b>1.1</b>	<b>3.1</b>	<b>1.9</b>	<b>27.0</b>

## 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	<b>3239</b>	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	<b>2546</b>	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	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	<b>3122</b>	<b>29.6</b>	<b>.635</b>	<b>.291</b>	<b>.477</b>	2.2	18.6	10.8	26.7	1.7	1.5	12.2	<b>33.0</b>	<b>14.8</b>	<b>4.4</b>	<b>19.2</b>	<b>.295</b>	<b>8.8</b>	<b>1.4</b>	<b>10.2</b>	<b>9.6</b>	
2014-15	26	OKC	NBA	SF	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	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	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	628	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	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			<b>32462</b>	<b>25.2</b>	<b>.615</b>	<b>.262</b>	<b>.410</b>	<b>2.3</b>	<b>18.6</b>	<b>10.8</b>	<b>19.8</b>	<b>1.5</b>	<b>2.3</b>	<b>12.5</b>	<b>30.2</b>	<b>104.7</b>	<b>42.0</b>	<b>146.7</b>	<b>.217</b>	<b>6.0</b>	<b>0.7</b>	<b>6.7</b>	<b>7.1</b>	

Total \$232,042,892 (\$249,682,672\*)

# Scraping Workflow

Prev Year  
Salary  
(Feature)

**2019 Free Agent Tracker**

**287 Free Agents** Share & Export ▾ Glossary

Rk	Player	Pos	Age	Type	OTm	2018-19 Stats	WS	NTm	Terms	Notes
1	<a href="#">Kevin Durant</a>	F-G	32-283	UFA	<a href="#">GSW</a>	26.0 Pts, 6.4 Reb, 5.9 Ast	11.5	<a href="#">BRK</a>	Signed 4-yr \$164.25M contract with GSW as part of sign-and-trade	
2	<a href="#">Nikola Vučević</a>	C	30-258	UFA	<a href="#">ORL</a>	20.8 Pts, 12.0 Reb, 3.8 Ast	10.1	<a href="#">ORL</a>	Signed 4-yr \$100M contract	
3	<a href="#">Kawhi Leonard</a>	F	30-010	UFA	<a href="#">TOR</a>	26.6 Pts, 7.3 Reb, 3.3 Ast	9.5	<a href="#">LAC</a>	Signed 3-yr \$103.13M contract	
4	<a href="#">Kyrie Irving</a>	G	29-108	UFA	<a href="#">BOS</a>	23.8 Pts, 5.0 Reb, 6.9 Ast	9.1	<a href="#">BRK</a>	Signed 4-yr \$136.49M contract	
5	<a href="#">Jimmy Butler</a>	F-G	31-298	UFA	<a href="#">PHI</a>	18.7 Pts, 5.3 Reb, 4.0 Ast	7.9	<a href="#">MIA</a>	Signed 4-yr \$140.79M contract with PHI as part of sign-and-trade	
6	<a href="#">Al Horford</a>	C-F	35-036	UFA	<a href="#">BOS</a>	13.6 Pts, 6.7 Reb, 4.2 Ast	7.5	<a href="#">PHI</a>	Signed 4-yr \$109M contract	
7	<a href="#">Kemba Walker</a>	G	31-062	UFA	<a href="#">CHO</a>	25.6 Pts, 4.4 Reb, 5.9 Ast	7.4	<a href="#">BOS</a>	Signed 4-yr \$140.79M contract with CHO as part of sign-and-trade	

Next Year  
Salary  
(Target)

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

**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
4. Chris Paul	\$35,654,150	\$36,475,929

**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

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

**2019/20 NBA Player Salaries**

**GO IN-DEPTH**

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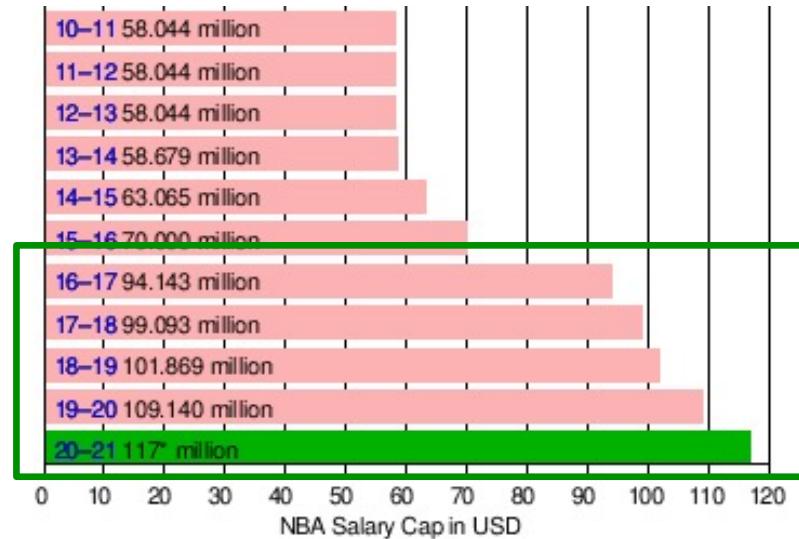
**PLAYER SALARIES**

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

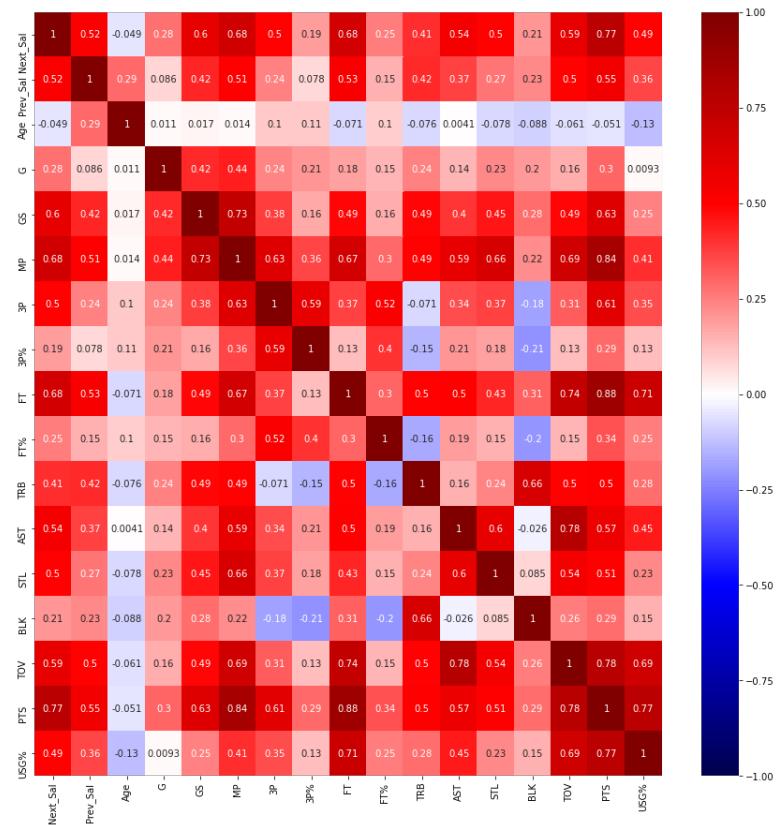
- Removed players who didn't play previous year or next year
  - Normalized salaries to 2020 salary cap
  - Free agent years: 2017, 2018, 2019, 2020



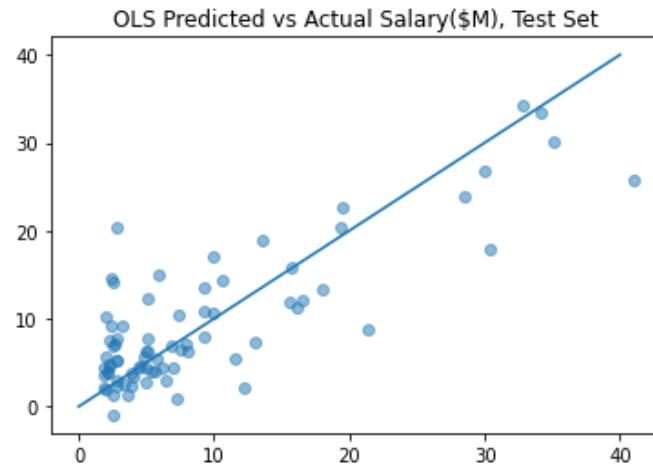
- Final Table: 381 rows, ~30 features

# Feature Engineering

- Looked at **correlation matrix**, **p-values**, and **pair plots** for inspiration
- Removed several unimportant features
- Added polynomial terms:
  - (Minutes per game)<sup>2</sup>
  - (Points per game)<sup>2</sup>
  - (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

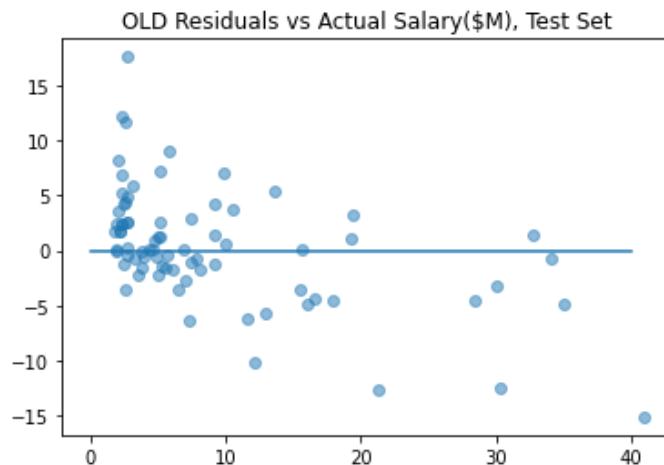


OLS R2 Train 0.736610775968946

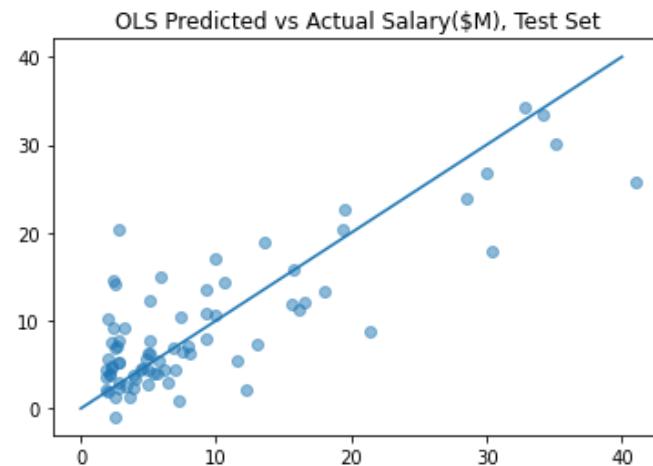
OLS R2 Test 0.6648322578341601

OLS MAE Test 3.710527757807454 (\$M)

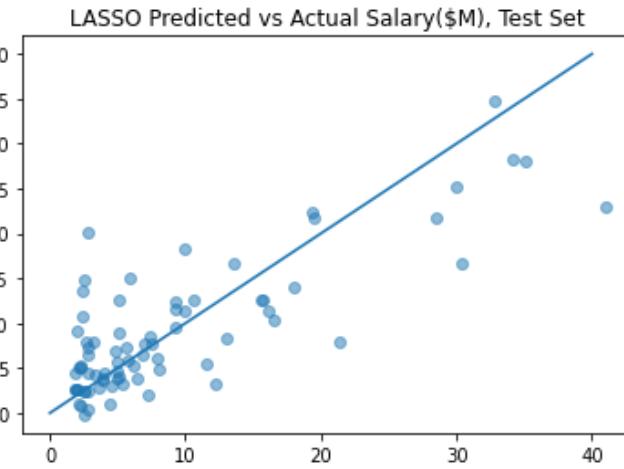
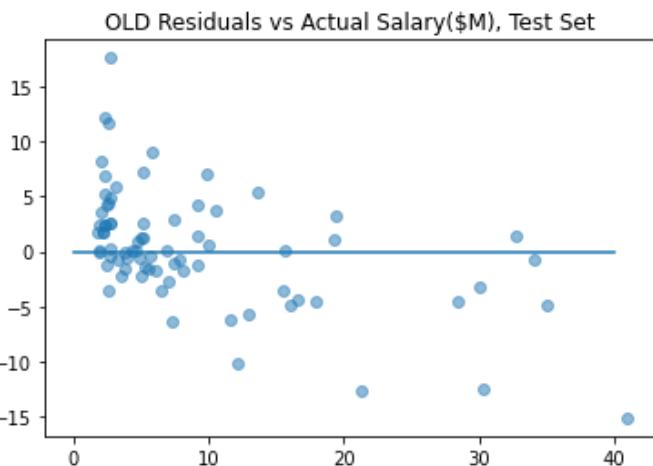
OLS RMSE Test 5.2519191522377735 (\$M)



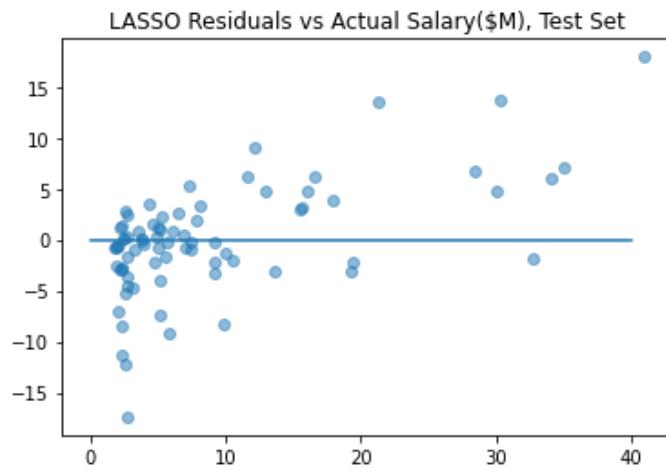
# Model 2: Cross-Val Regularized LASSO



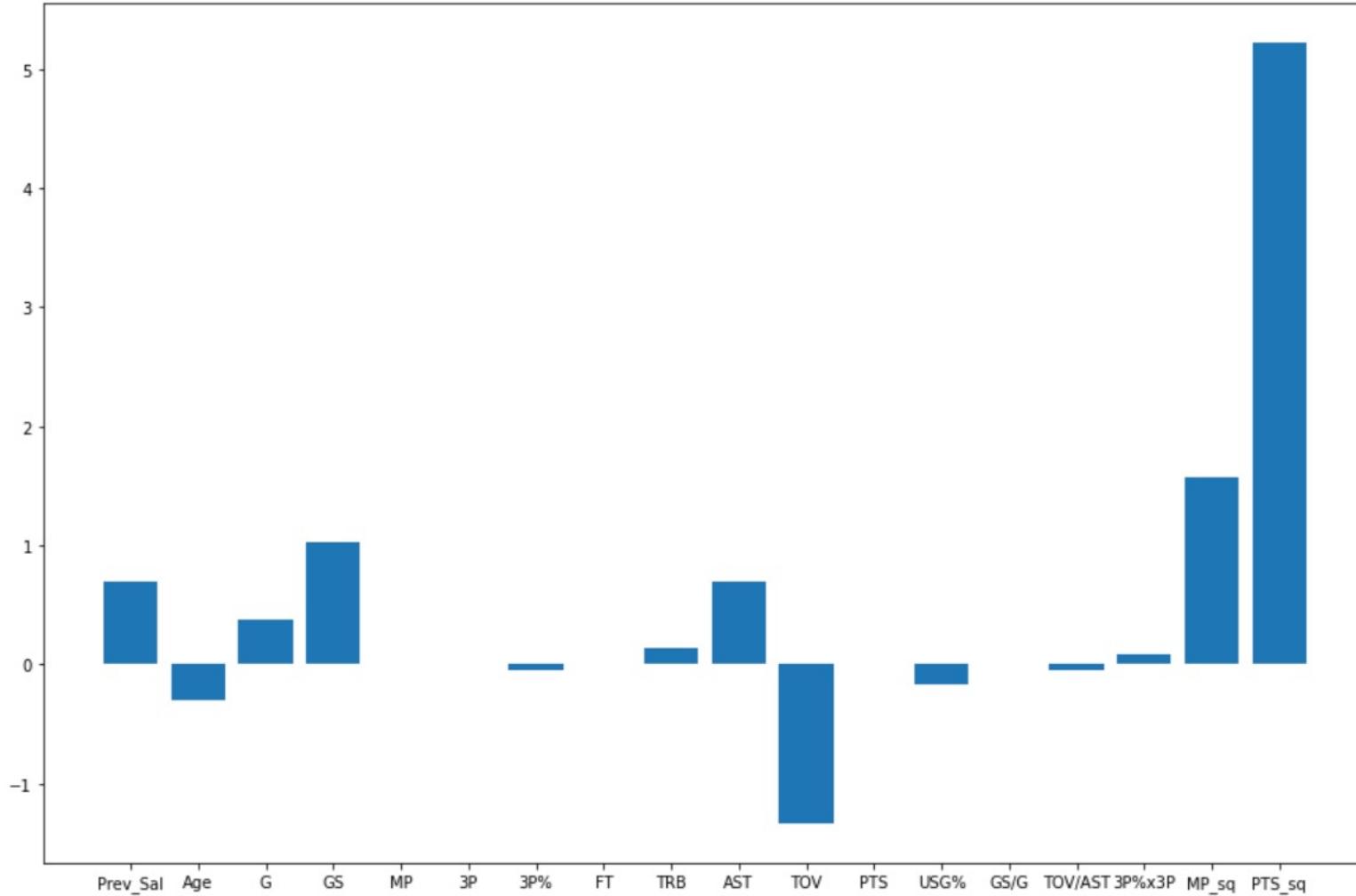
OLS MAE Test 3.710527757807454 (\$M)  
OLS RMSE Test 5.2519191522377735 (\$M)



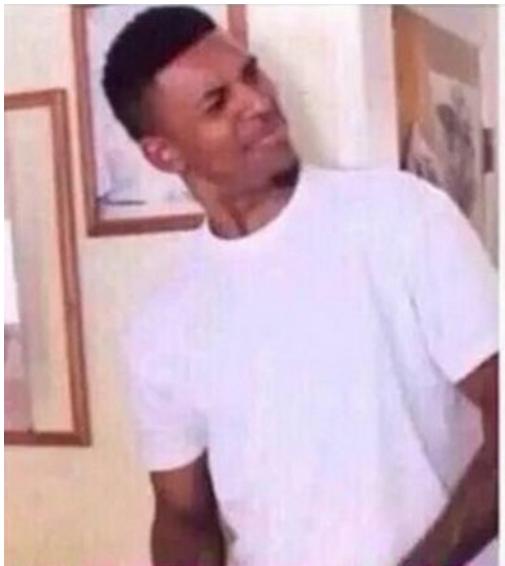
LASSO MAE Test 3.7738943842347004 (\$M)  
LASSO RMSE Test 5.438523561429468 (\$M)



# 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?

