

# Calculating NBA MVPs Using Advanced Sports Analytics

By Max Shen and Gergő Nagy



Wharton Moneyball Academy Training Camp 2023, Sports Analytics Student Research Journal

# Background

---

- The NBA MVP, given since the 1955–56 season, is the most prestigious individual award in professional basketball. It is an annual National Basketball Association (NBA) award received by the best performing player of the regular season. While the criteria for the award is subjective, advanced sports analytics can provide a more objective method to measure player performance and identify the most deserving MVP candidate each season.
- In this project, we will use advanced sports analytics to create a model for calculating the 2023 NBA MVP. We will collect data on player statistics, team performance, and other relevant factors to create a comprehensive model that takes into account all aspects of a player's performance.

# Methodology

---

- **Data Collection:** We will gather data on player statistics, team performance, and other relevant factors from various sources such as NBA.com, basketball-reference.com, and other sports analytics websites.
- **Model Building:** We will create new features based on the existing data, such as player efficiency rating (PER), true shooting percentage (TS%), Offensive/Defensive rating, usage rate, and win shares to create our model via R Studios. With those features, we will implement our own created statistics—ShenNagy MVP value—which will be used to calculate and form our predictions for the 2022-2023 season MVP.
- **MVP Prediction:** Finally, we will use the model to predict the MVP winners from 2006-2022 and compare it with the actual MVP winner to evaluate the model's effectiveness and accuracy. We will place a focus on the 2016-2017 season, as it was deemed one of the most competitive MVP race. Then evaluate the 2022-2023 season and predict the MVP winner.

## NBA MVPs from 2006-2022

# Data Collection:

- First, we analyzed NBA MVPs and winners from 2006 to present, with a focus on the highly competitive 2016-2017 season. We scrutinized the top 10 players who performed exceptionally and compared their base statistics. Next, we then also evaluated the top 10 players who are currently performing strongly in the 2022-2023 season.

### Base Basketball Statistics:

- GM, GP; GS: games played; games started
- PTS: points FGM, FGA, FG%: field goals made, attempted and percentage
- FTM, FTA, FT%: free throws made, attempted and percentage
- 3FGM, 3FGA, 3FG%: three-point field goals made, attempted and percentage
- REB, OREB, DREB: rebounds, offensive rebounds, defensive rebounds
- AST: assists
- STL: steals
- BLK: blocks
- TO: turnovers

### Advanced Statistics:

- Player Efficiency Rating (PER)

$$PER = \frac{PTS + 0.4 * REB + 0.15 * AST + 0.15 * STL + 0.15 * BLK + 0.4 * FGM - 0.4 * FGA - 0.4 * FTA + 0.15 * TO}{MIN} * 100$$

- True Shooting Percentage (TS%)

$$TS\% = \frac{0.5 * PTS}{FGA + 0.475 * FTA}$$

- Offensive and Defensive Rating

$$ORTg = 100 * (PPProd / TotPoss)$$

$$DRTg = 100 * (100 - (100 - 0.4 * PPA - 0.4 * PPF - 0.1 * PTO) / TotPoss)$$

- Usage Rate

$$USR\% = \frac{100 * (0.33 * AST + FGA + 0.44 * FTA + TO)}{POSS}$$

- Win Shares

$$\text{Win Shares} = (\text{marginal offense}) / (\text{marginal points per win}).$$

YEAR	PLAYER	POS	TEAM	FG%	PPG	RPG	APG	BLKPG
2022	Nikola Jokic	C	Denver Nuggets	.583	27.1	13.8	7.9	0.9
2021	Nikola Jokic	C	Denver Nuggets	.566	26.4	10.8	8.3	0.7
2020	Giannis Antetokounmpo	F	Milwaukee Bucks	.553	29.5	13.6	5.6	1.0
2019	Giannis Antetokounmpo	F	Milwaukee Bucks	.578	27.7	12.5	5.9	1.5
2018	James Harden	G	Houston Rockets	.449	30.4	5.4	8.8	0.7
2017	Russell Westbrook	G	Oklahoma City Thunder	.425	31.6	10.7	10.4	0.4
2016	Stephen Curry	G	Golden State Warriors	.504	30.1	5.4	6.7	0.2
2015	Stephen Curry	G	Golden State Warriors	.487	23.8	4.3	7.7	0.2
2014	Kevin Durant	F	Oklahoma City Thunder	.503	32.0	7.4	5.5	0.7
2013	LeBron James	F	Miami Heat	.565	26.8	8.0	7.3	0.9
2012	LeBron James	SF	Miami Heat	.531	27.1	7.9	6.2	0.8
2011	Derrick Rose	PG	Chicago Bulls	.445	25.0	4.1	7.7	0.6
2010	LeBron James	SF	Cleveland Cavaliers	.503	29.7	7.3	8.6	1.0
2009	LeBron James	SF	Cleveland Cavaliers	.489	28.4	7.6	7.2	1.1
2008	Kobe Bryant	SF	Los Angeles Lakers	.459	28.3	6.3	5.4	0.5
2007	Dirk Nowitzki	F	Dallas Mavericks	.502	24.6	8.9	3.4	0.8

## Top 10 Players 2016-2017

Rank	Player	Age	Tm	Voting			Per Game					Shooting					
				First	Pts Won	Pts Max	Share	G	MP	PTS	TRB	AST	STL	BLK	FG%	3P%	FT%
1	<a href="#">Russell Westbrook</a>	28	<a href="#">OKC</a>	69.0	888.0	1010	0.879	81	34.6	31.6	10.7	10.4	1.6	0.4	.425	.343	.845
2	<a href="#">James Harden</a>	27	<a href="#">HOU</a>	22.0	753.0	1010	0.746	81	36.4	29.1	8.1	11.2	1.5	0.5	.440	.347	.847
3	<a href="#">Kawhi Leonard</a>	25	<a href="#">SAS</a>	9.0	500.0	1010	0.495	74	33.4	25.5	5.8	3.5	1.8	0.7	.485	.380	.880
4	<a href="#">LeBron James</a>	32	<a href="#">CLE</a>	1.0	333.0	1010	0.330	74	37.8	26.4	8.6	8.7	1.2	0.6	.548	.363	.674
5	<a href="#">Isaiah Thomas</a>	27	<a href="#">BOS</a>	0.0	81.0	1010	0.080	76	33.8	28.9	2.7	5.9	0.9	0.2	.463	.379	.909
6	<a href="#">Stephen Curry</a>	28	<a href="#">GSW</a>	0.0	52.0	1010	0.051	79	33.4	25.3	4.5	6.6	1.8	0.2	.468	.411	.898
7T	<a href="#">Giannis Antetokounmpo</a>	22	<a href="#">MIL</a>	0.0	7.0	1010	0.007	80	35.6	22.9	8.8	5.4	1.6	1.9	.521	.272	.770
7T	<a href="#">John Wall</a>	26	<a href="#">WAS</a>	0.0	7.0	1010	0.007	78	36.4	23.1	4.2	10.7	2.0	0.6	.451	.327	.801
9T	<a href="#">Anthony Davis</a>	23	<a href="#">NOP</a>	0.0	2.0	1010	0.002	75	36.1	28.0	11.8	2.1	1.3	2.2	.505	.299	.802
9T	<a href="#">Kevin Durant</a>	28	<a href="#">GSW</a>	0.0	2.0	1010	0.002	62	33.4	25.1	8.3	4.8	1.1	1.6	.537	.375	.875
11	<a href="#">DeMar DeRozan</a>	27	<a href="#">TOR</a>	0.0	1.0	1010	0.001	74	35.4	27.3	5.2	3.9	1.1	0.2	.467	.266	.842

## Top 10 Players 2022-2023

Rk	Player	Team	W	L	W/L%	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
1	<a href="#">Nikola Jokic</a>	<a href="#">DEN</a>	53	29	.646	69	69	33.7	9.4	14.8	.632	0.8	2.2	.383	8.5	12.7	.675	.660	4.9	6.0	.822	2.4	9.4	11.8	9.8	1.3	0.7	3.6	2.5	24.5
2	<a href="#">Joel Embiid</a>	<a href="#">PHI</a>	54	28	.659	66	66	34.6	11.0	20.1	.548	1.0	3.0	.330	10.0	17.1	.587	.573	10.0	11.7	.857	1.7	8.4	10.2	4.2	1.0	1.7	3.4	3.1	33.1
3	<a href="#">Giannis Antetokounmpo</a>	<a href="#">MIL</a>	58	24	.707	63	63	32.1	11.2	20.3	.553	0.7	2.7	.275	10.5	17.6	.596	.572	7.9	12.3	.645	2.2	9.6	11.8	5.7	0.8	0.8	3.9	3.1	31.1
4	<a href="#">Jayson Tatum</a>	<a href="#">BOS</a>	57	25	.695	74	74	36.9	9.8	21.1	.466	3.2	9.3	.350	6.6	11.8	.558	.543	7.2	8.4	.854	1.1	7.7	8.8	4.6	1.1	0.7	2.9	2.2	30.1
5	<a href="#">James Harden</a>	<a href="#">PHI</a>	54	28	.659	58	58	36.8	6.4	14.5	.441	2.8	7.2	.385	3.6	7.3	.495	.536	5.4	6.2	.867	0.7	5.4	6.1	10.7	1.2	0.5	3.4	1.9	21.0
6	<a href="#">Domantas Sabonis</a>	<a href="#">SAC</a>	48	34	.585	79	79	34.6	7.3	11.9	.615	0.4	1.1	.373	6.9	10.8	.639	.632	4.1	5.5	.742	3.2	9.1	12.3	7.3	0.8	0.5	2.9	3.5	19.1
7	<a href="#">Luka Dončić</a>	<a href="#">DAL</a>	38	44	.463	66	66	36.2	10.9	22.0	.496	2.8	8.2	.342	8.1	13.8	.588	.560	7.8	10.5	.742	0.8	7.8	8.6	8.0	1.4	0.5	3.6	2.5	32.4
8	<a href="#">Jimmy Butler</a>	<a href="#">MIA</a>	44	38	.537	64	64	33.4	7.5	13.9	.539	0.6	1.6	.350	6.9	12.3	.564	.560	7.4	8.7	.850	2.2	3.7	5.9	5.3	1.8	0.3	1.6	1.3	22.9
9	<a href="#">Shai Gilgeous-Alexander</a>	<a href="#">OKC</a>	40	42	.488	68	68	35.5	10.4	20.3	.510	0.9	2.5	.345	9.5	17.8	.533	.531	9.8	10.9	.905	0.9	4.0	4.8	5.5	1.6	1.0	2.8	2.8	31.4
10	<a href="#">Damian Lillard</a>	<a href="#">POR</a>	33	49	.402	58	58	36.3	9.6	20.7	.463	4.2	11.3	.371	5.4	9.4	.574	.564	8.8	9.6	.914	0.8	4.0	4.8	7.3	0.9	0.3	3.3	1.9	32.2

# Model Building

- From the base statistics we have collected, we have calculated the advanced statistics for all 36 players.

Rank	Player	Age	Tm	First	Pts won	Pts Max	Share	G	MP	PTS	TRB	AST	STL	BLK	FG%	3P%	FT%	WS	PER	TSP	UR	OR	DR
1	Russell Westbrook	28	OKC	69	888	1010	0.879	81	34.6	31.6	10.7	10.4	1.6	0.4	0.425	0.343	0.845	13.1	30.7	55.4	40.2	111.	106.
2	James Harden	27	HOU	22	753	1010	0.746	81	36.4	29.1	8.1	11.2	1.5	0.5	0.44	0.347	0.847	15	27.4	61.3	33.3	116.	109.
3	Kawhi Leonard	25	SAS	9	500	1010	0.495	74	33.4	25.5	5.8	3.5	1.8	0.7	0.485	0.38	0.88	13.6	27.6	61	30.6	114.	105.
4	LeBron James	32	CLE	1	333	1010	0.33	74	37.8	26.4	8.6	8.7	1.2	0.6	0.548	0.363	0.674	12.9	27.1	61.9	29.2	117.	108.
5	Isaiah Thomas	27	BOS	0	81	1010	0.08	76	33.8	28.9	2.7	5.9	0.9	0.2	0.463	0.379	0.909	12.5	26.6	62.5	33.2	115.	110.
6	Stephen Curry	28	GSW	0	52	1010	0.051	79	33.4	25.3	4.5	6.6	1.8	0.2	0.468	0.411	0.898	12.6	24.7	62.4	28.6	120.	103.
7	Giannis Antetokounmpo	22	MIL	0	7	1010	0.007	80	35.6	22.9	8.8	5.4	1.6	1.9	0.521	0.272	0.77	12.4	26.1	59.9	28	109.	108.
8	John Wall	26	WAS	0	7	1010	0.007	78	36.4	23.1	4.2	10.7	2	0.6	0.451	0.327	0.801	8.8	23.3	54.1	29.9	113	109.
9	Anthony Davis	23	MOP	0	2	1010	0.002	75	36.1	28	11.8	2.1	1.3	2.2	0.505	0.299	0.802	11	27.6	58	32.1	109.	104.
10	Kevin Durant	28	GSW	0	2	1010	0.002	62	33.4	25.1	8.3	4.8	1.1	1.6	0.537	0.375	0.875	12	27.7	65.1	27.1	118	102.
11	DeMar DeRozan	27	TOR	0	1	1010	0.001	74	35.4	27.3	5.2	3.9	1.1	0.2	0.467	0.266	0.842	9	24.1	55.2	33.7	111.	109.

Season	Player	PER
2021-2022	Nikola Jokic	32.94
2020-2021	Nikola Jokic	31.36
2019-2020	Giannis Antetokounmpo	31.94
2018-2019	Giannis Antetokounmpo	30.95
2017-2018	James Harden	29.87
2016-2017	Russel Westbrook	30.7
2015-2016	Stephen Curry	31.56
2014-2015	Stephen Curry	30.89
2013-2014	Kevin Durant	29.9
2012-2013	LeBron James	31.67
2011-2012	LeBron James	30.8
2010-2011	Derrick Rose	37.34
2009-2010	LeBron James	31.19
2008-2009	LeBron James	31.76
2007-2008	Kobe Bryant	24.09
2006-2007	Dirk Nowitzki	27.7

- We have identified Player Efficiency Rating (PER) as the most accurate correlation with MVP winners. Almost all MVPs from 2006-2022 have had the highest PER among other players over the season, with the exceptions of Kobe Bryant and Dirk Nowitzki.
- Now, we are creating our own statistical model using advanced statistics, known as the ShenNagy MVP value. The model will focus on PER, True Shooting Percentage, Offensive and Defensive Rating, and use Usage Rates and Winshares as prerequisites. The formula for the ShenNagy MVP value will be:

# Model Building

$PERR (PER / \text{highest PER in top 10}) + Cor(WS, PER) * WSR(\text{Win Shares} / \text{highest Win Shares}) + Cor(USG, PER) * USGR + \dots$

$$PERR \left( \frac{PER}{\text{highest PER in top 10}} \right) + Cor(WS, PER) \times WSR \left( \frac{\text{Win Shares}}{\text{Highest Win Shares}} \right) + Cor(USG, PER) \cdot USGR$$

We calculated the correlation between each of the advanced statistics mentioned. Next, we created a rate for each variable by dividing its value with the highest value among the ten observations. We then multiplied each variable rate with its corresponding correlation factor. Finally, we added up all the products to obtain a balanced sum based on Player Efficiency Rating (PER). It's worth noting that PER is highly offensive-biased, which aligns well with the MVP selection process.

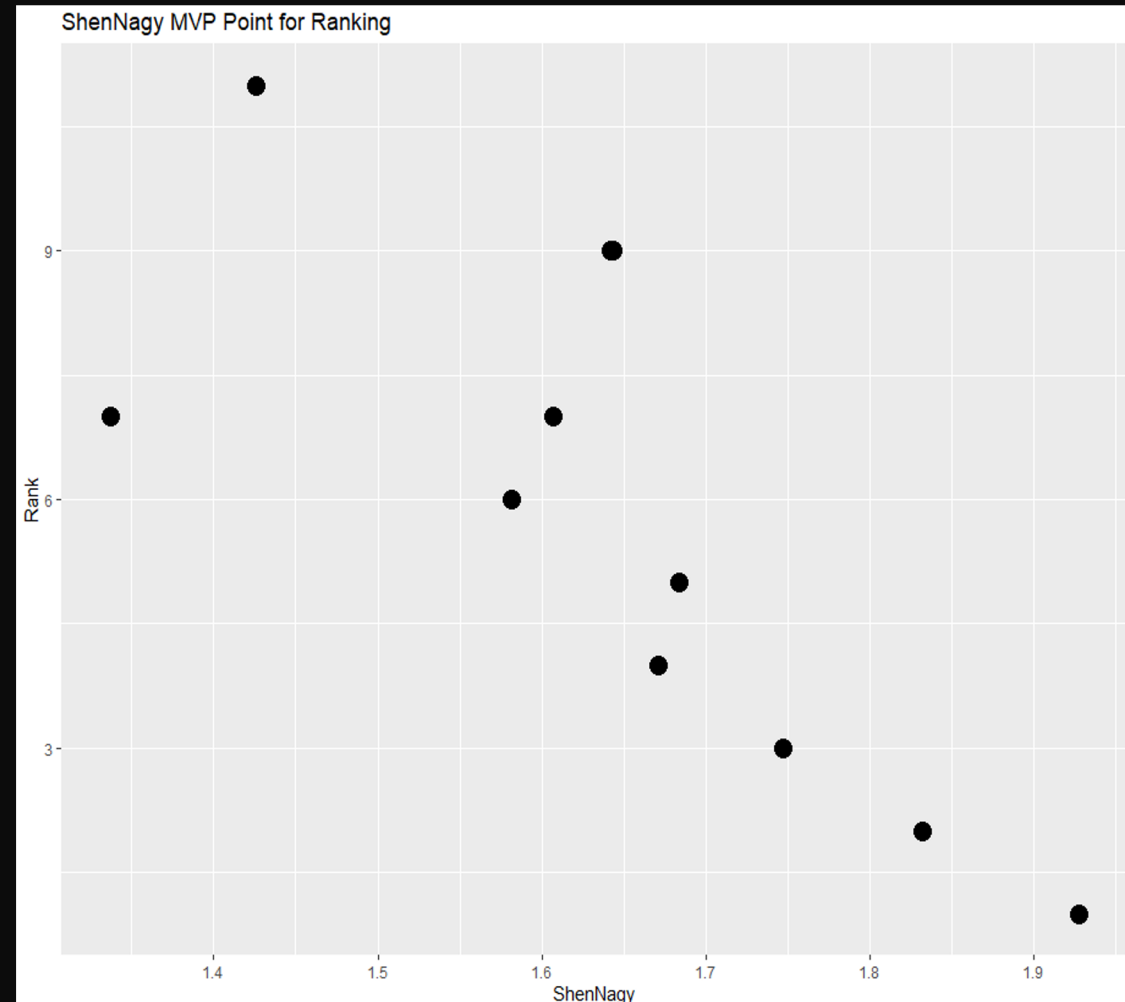
# Applying ShenNagy Model to 2016-2017:

## Correlation Factors

- PERR -> 1
- WSR -> 0.655
- USGR -> 0.500
- TSPR -> 0.207
- ORR -> -0.162
- DRR -> -0.240

```
> cor(players$ShenNagy, players$Rank)
[1] -0.7651594
```

Rank	Player	ShenNagy
<dbl>	<chr>	<dbl>
1	1 Russell westbrook	1.93
2	2 James Harden	1.83
3	3 Kawhi Leonard	1.75
4	4 LeBron James	1.67
5	5 Isaiah Thomas	1.68
6	6 Stephen Curry	1.58
7	7 Giannis Antetokounmpo	1.61
8	7 John wall	1.34
9	9 Anthony Davis	1.64
10	9 Kevin Durant	1.64
11	11 DeMar DeRozan	1.43

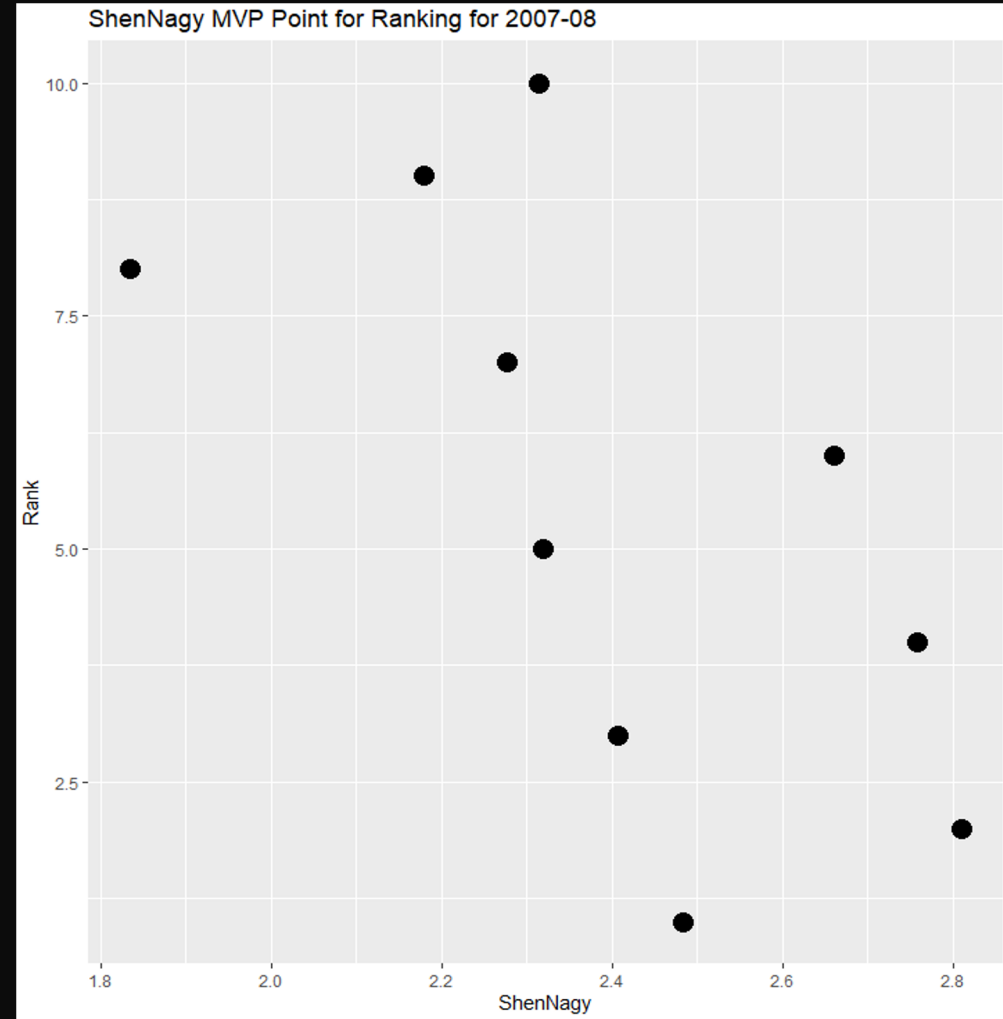


# Applying Model to 2006-2022:

After applying the ShenNagy Model to all 16 seasons, we have successfully predicted 15/16 seasons, which put us at a 93.75% accuracy rate. The only misprediction was the 2007-2008 season, while Kobe still ranked top 5 for ShenNagy MVP value, the ShenNagy model places Chris Paul first instead. We later on researched this year, and found many fans, critics, and sources claiming Chris Paul was "snubbed" or "robbed" of an MVP and instead preferred ShenNagy MVP winner instead. Articles about the snub: Bleacher Report: [Why Kobe Bryant Should Give the MVP to Chris Paul](#), Sports Keeda: [5 Biggest Snubs of the 21th Century](#)

Rank	Player	ShenNagy
1	"Kobe Bryant"	2.48
2	"Chris Paul"	2.81
3	"Kevin Garnett"	2.41
4	"LeBron James"	2.76
5	"Dwight Howard"	2.32
6	"Amar'e Stoudemire"	2.66
7	"Tim Duncan"	2.28
8	"Tracy McGrady"	1.83
9	"Steve Nash"	2.18
10	"Manu Ginobili"	2.31

```
> cor(players$ShenNagy, players$Rank)  
[1] -0.6209075
```





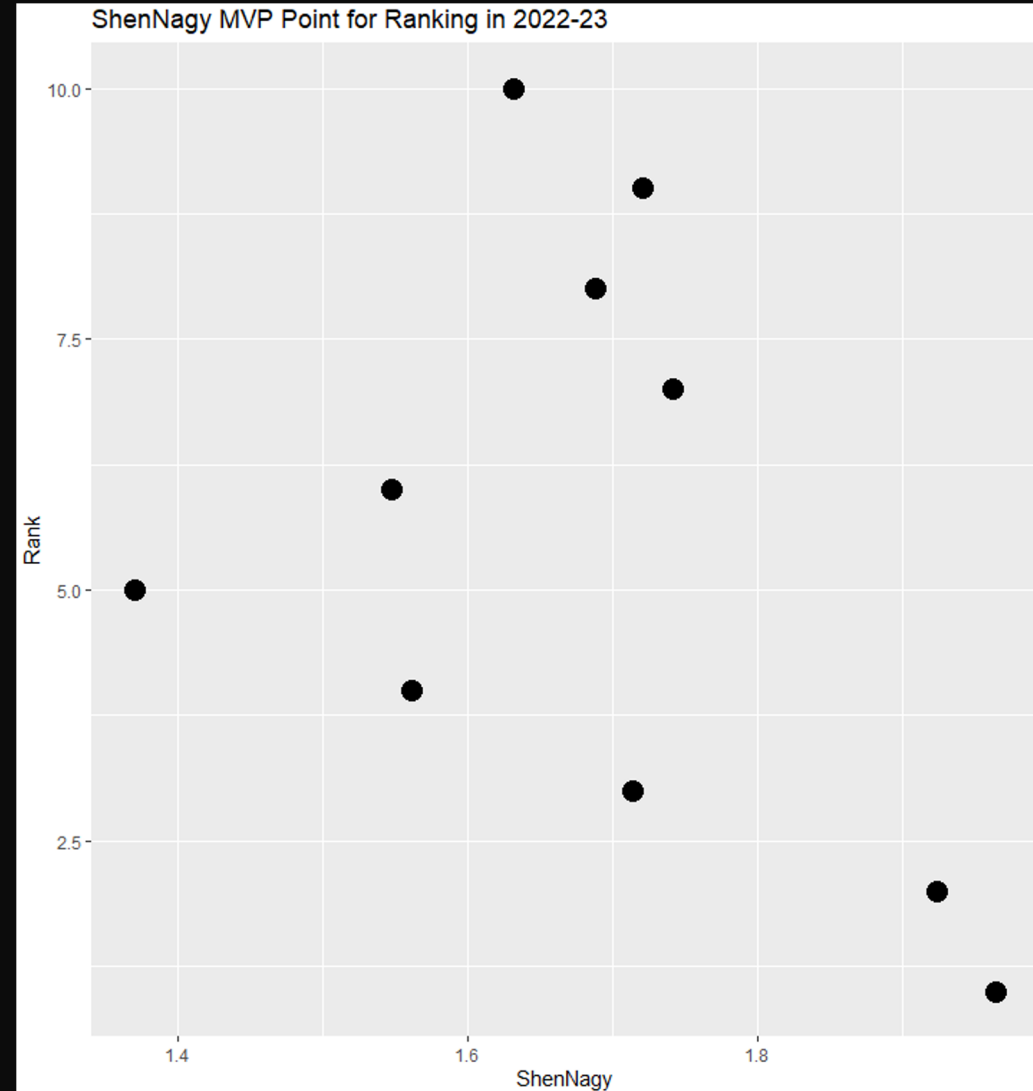
# Applying ShenNagy Model to 2022-2023:

Correlation factors

- PER -> 1
- WSR -> 0.4647094
- USGR -> 0.3567048
- TSPR -> 0.5258898
- ORR -> 0.05929663
- DRR -> -0.3659621

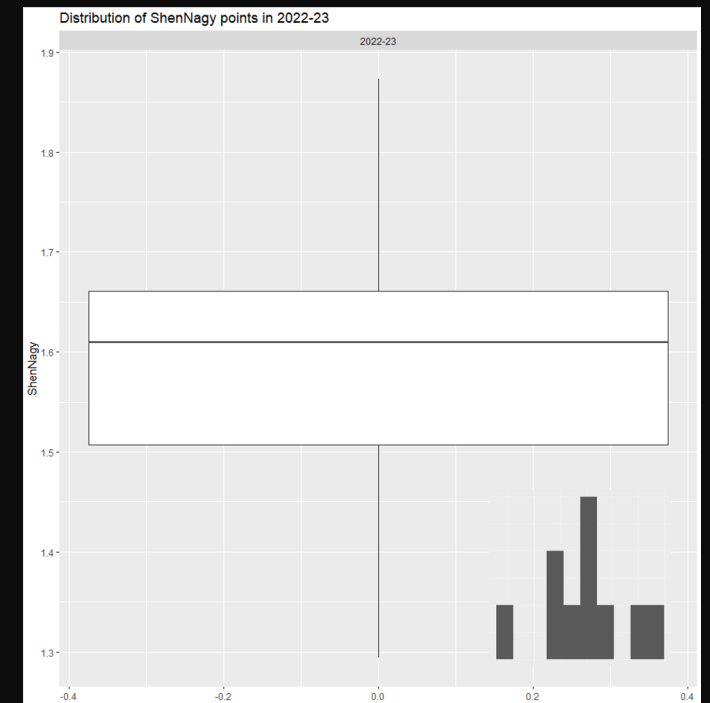
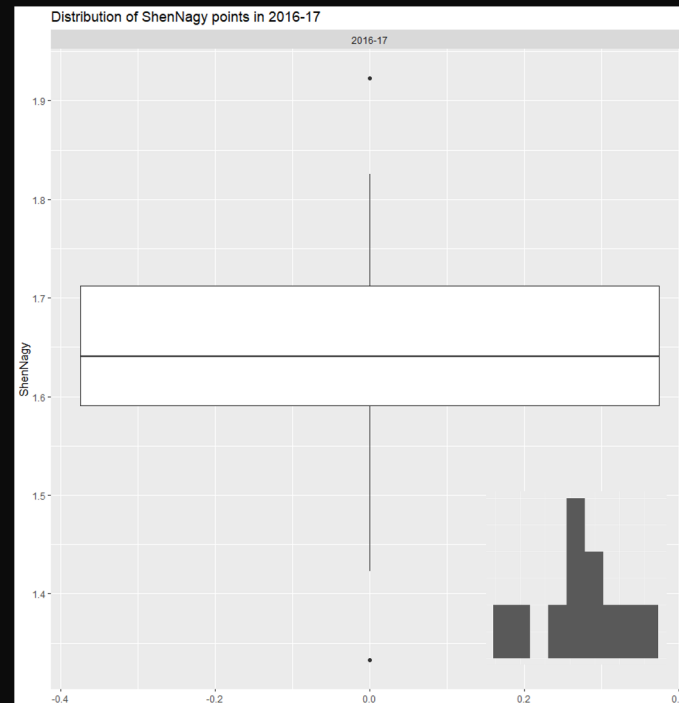
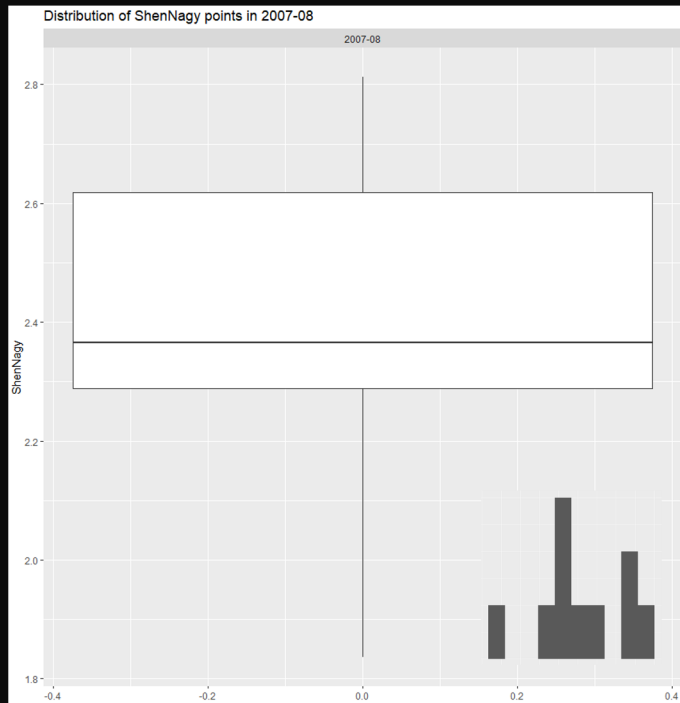
```
> cor(players$WSR, players$PERR)
[1] 0.4647094
```

Rk	Player	ShenNagy
<dbl>	<chr>	<dbl>
1	1 Nikola Jokic	1.96
2	2 Joel Embiid	1.92
3	3 Giannis Antetokounmpo	1.71
4	4 Jayson Tatum	1.56
5	5 James Harden	1.37
6	6 Domantas Sabonis	1.55
7	7 Luka Doncic	1.74
8	8 Jimmy Butler	1.69
9	9 Shai Gilgeous-Alexander	1.72
10	10 Damian Lillard	1.63



# ShenNagy Model's Standard Deviation

Z-scores of leaders:  
Chris Paul – 1.38  
Russell Westbrook – 1.68  
Nikola Jokic – 1.56



The MVPs are usually around 1.5 SD from the mean, about the top 10%

# Conclusion

---

The ShenNagy MVP model is effective, but it performs best in determining the first few ranks, which typically have significant performance differences compared to the rest. The model accurately predicted 15 out of 16 seasons, resulting in a 93.75% accuracy rate. However, despite its slight inaccuracy, critics, fans, and other sources actually favored the ShenNagy model's predicted winner, Chris Paul.

This indicates that the ShenNagy MVP model is reliable and credible. Additionally, our model has predicted that *Nikola Jokić* will be the MVP of the 2022-23 season.

# References

---

- basketball-reference.com. "2016-2017 NBA Awards Voting." basketball-reference.com, [https://www.basketball-reference.com/awards/awards\\_2017.html](https://www.basketball-reference.com/awards/awards_2017.html).
- basketball-reference.com. "About the Statistical Measures." basketball-reference.com, <https://www.basketball-reference.com/about/ratings.html>.
- basketball-reference.com. "Most Valuable Player Award Winners." basketball-reference.com, <https://www.basketball-reference.com/friv/mvp.html>.
- basketball-reference.com. "Win Shares." basketball-reference.com, [https://www.basketball-reference.com/about/ws.html#:~:text=to%20the%20players.-,Offensive%20Win%20Shares%20are%20credited%20using%20the%20following%20formula%3A%20\(marginal,36.176%20%3D%2014.27%20Offensive%20Win%20Shares](https://www.basketball-reference.com/about/ws.html#:~:text=to%20the%20players.-,Offensive%20Win%20Shares%20are%20credited%20using%20the%20following%20formula%3A%20(marginal,36.176%20%3D%2014.27%20Offensive%20Win%20Shares).
- ESPN.com. "NBA Awards: Most Valuable Player." ESPN.com, [http://www.espn.com/nba/history/awards/\\_/id/33](http://www.espn.com/nba/history/awards/_/id/33).
- NBA.com. "Kia Race to the MVP Ladder." NBA.com, <https://www.nba.com/news/category/kia-race-to-the-mvp-ladder>.
- Wikipedia. "NBA Most Valuable Player Award." Wikipedia, [https://en.wikipedia.org/wiki/NBA\\_Most\\_Valuable\\_Player\\_Award#:~:text=The%20National%20Basketball%20Association%20Most,player%20of%20the%20regular%20season](https://en.wikipedia.org/wiki/NBA_Most_Valuable_Player_Award#:~:text=The%20National%20Basketball%20Association%20Most,player%20of%20the%20regular%20season).
- Wikipedia. "Player Efficiency Rating." Wikipedia, [https://en.wikipedia.org/wiki/Player\\_efficiency\\_rating](https://en.wikipedia.org/wiki/Player_efficiency_rating).
- Wolfram Cloud. "Basketball True Shooting Percentage." Wolfram Cloud, <https://resources.wolframcloud.com/FormulaRepository/resources/Basketball-True-Shooting-Percentage#:~:text=The%20true%20shooting%20percentage%20is,times%20the%20free%20throws%20attempted>.
- Wolfram Cloud. "Basketball Usage Rate." Wolfram Cloud, <https://resources.wolframcloud.com/FormulaRepository/resources/Basketball-Usage-Rate#:~:text=Usage%20rate%20estimates%20the%20percentage,all%20divided%20by%20the%20possessions>.