

1. NBA Four-Factor Model

In the current season, the Trail Blazers have as much losses as they did for all of the 2019. The main deficiency observed year over year is the extreme drop in rebounding production (Top 10 in ORB/DRB in 2019, bottom half of the league in 2020) shown in data from basketballreference.com (Appendix A). This is more of a bi-product of who isn't on the court this year through offseason moves and injuries. Team Leaders in TRB such as Enes Kanter (TRB: 8.6/g), Al-Farouq Aminu (TRB: 7.5/g), Maurice Harkless (TRB: 4.5/g) were replaced with Kent Bazemore (TRB: 4/g) and Hassan Whiteside (TRB: 14.1/g). The real deficit is from 2019 team leader, Jusuf Nurkic (TRB: 10.4/g) and starting PF, Zack Collins (TRB: 4.2/g) have been out due to injuries. The one bright spot may be the consistency of Offensive EFG & DEF EFG despite the shuffle of lineup & injuries. This may be more of a highlight to Terry Stotts's system of getting

	Team	W	L	Off_ORB.	Def_DRB.	ORBrank	DRBrank	year
6	Portland Trail Blazers*	53	29	26.6	77.9	1	8	2019
16	Portland Trail Blazers	23	28	22.1	75.0	17	20	2020

players to play consistently on defense.

**Data from Basketball Reference*

2. Games Won from Four Factors

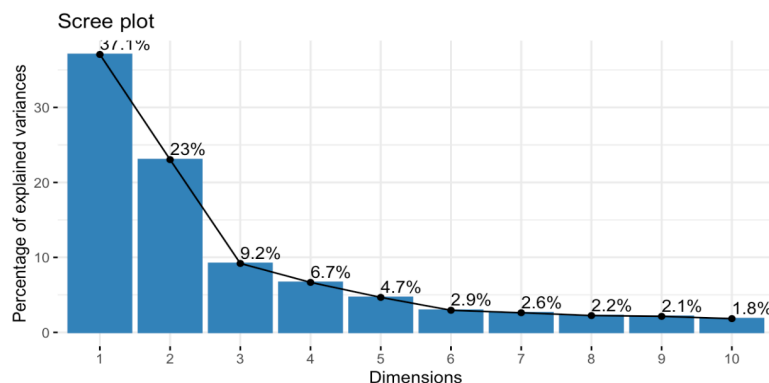
The games won model uses the Four Factors differentials (i.e. Offensive EFG – Defensive EFG) to predict games won. The Blazers should have won ~47 games in 2018-2019 season (“gw_pred”) and they actually outperformed that statistics by ~5.8 games (residuals) as a result and won 53 games. The RME or relative accuracy of the model was 4 games, which indicates the Blazers outperformed their prediction by a larger margin. The main areas of efficiency for

the Blazers were a positive EFG of 1% whereas most team's average in 2019 was - 0.01%. This is shows that Blazers are an efficient scoring team and play good defense (9 players with above average EFG percent in 2019 for players that played in 20+ games.

	Team	W	L	EFG	TOV	RB	FT_FGA	gw_pred	residuals
6	Portland Trail Blazers*	53	29	0.012	1.1	-51.3	0.015	47.16343	5.836572

3. NBA Classification Model

In building a new player position cluster, we fit 10 years of per game data and only included players that had played with a team for over 30 games (this helps to account for players that could have had different roles with new teams). We included 36 variables (Appendix D) around minutes played (mp), shooting (FG, X2P, X3P, EFG, FT), rebounding, defense, ball handling efficiency, etc. and made sure to scale all of the variables to ensure equal opportunity for each variable's importance in clustering. This make sure rebounds and points are compared based on importance rather than amount of total counts. From there, we fit a Principal Components Analysis (PCA) to reduce the dimension to understand in order to see that 10 components accounts for 92.3% of the variability (shown in the scree plot):

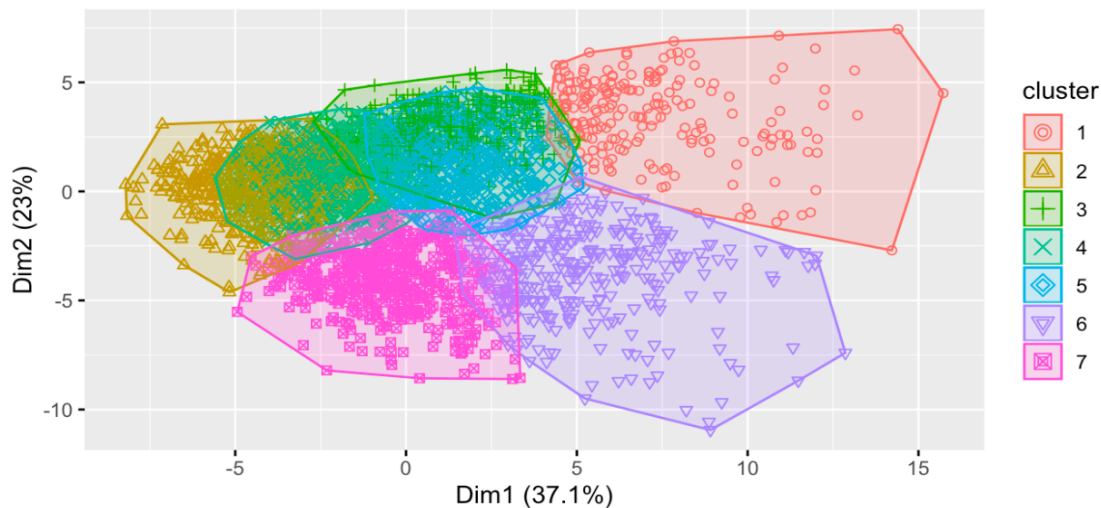


The components consist of scoring (1st), rebounding (2nd), scoring efficiency (3rd), ball-handling (4th), and free-throws (5th). After the 5th principal, we see very specific uses such as **tovpercent**,

stlpercent, **blks**, pf or fouls, free throw percentage. Using a k-means cluster method and observing the elbow method, we derive that there are 7 clusters (account for 53% of explained data). The seven clusters are as followed:

- Cluster 1 – “Primary Scorers” (e.g. Devin Booker, Stephen Curry, Luka Doncic)
- Cluster 2 – “Driving/Efficient Scorers” (e.g. Devonte’ Graham, Tyreke Evens, Troy Brown)
- Cluster 3 - “Primary Ball-handlers” (e.g. Lonzo Ball, Draymond Green, Goran Dragic)
- Cluster 4 – “Perimeter Shooters” (e.g. OG Anunoby, Avery Bradley, Kyle Korver)
- Cluster 5 – “Perimeter Wings/Defenders” (e.g. Trevor Ariza, Nicolas Batum, Patrick Beverly)
- Cluster 6 – “Scoring Low-post Bigs” (e.g. Lamarcus Aldridge, Anthony Davis, Joel Embiid)
- Cluster 7 – “Defensive Bigs” (e.g. Tyson Chandler, Jordan Bell, Bam Adebayo)

Cluster plot



Cluster 1 usually lead the team in scoring and usually your team’s all-stars. Cluster 2 are your typical role players but don’t excel at 3 points shooting (Cluster 4). Cluster 3 excel at assist categories. Cluster 4 are usually perimeter scoring (have higher 3pt %and EFG %). We can see above that clusters 2,3,4 have high overlap, which separates their specific scoring specialty. Cluster 5 is hard to distinguish because their offense stats could be within 2,3,4 but individuals in this cluster have higher than average stls and stl percentage. Cluster 6 and 7 are clear

clusters of low-post players in the NBA and separated out if the big is a primary scorer versus a primary defender (higher X2P & EFG). Both of these clusters excel at rebounding.

Current Roster Cluster

The below table shows current blazers with at least 30 games played in 2019. The table is missing individuals on the 2020 team is Carmelo Anthony, Nassir Little, Anfernee Simmons, and Gary Trent Jr. who have been key contributors in the current season but don't have threshold of games played to be given a cluster. Whiteside has been a primary scoring big for the Blazers this year but that's been with Nurkic out of the lineup. He'll likely be reclassified to a 7 and focus on defense and rebounding when Jusuf returns. McCollum is likely a 1 but plays good enough perimeter defense for the team overall. The team should look to scout an efficient driving scorer (2) to create opportunities for scoring "biggs" and perimeter wings. Given the team's woes in rebounding it may be worthwhile to find a defensive big of a 7 to add to the rotation. Montrezl Harrell for the Clippers has historically been a 7, if the Blazers do not decide to retain Hassan Whiteside's contract, he could be acquisition target for the Blazers to replace Whiteside's 14.1 TRB per game. Driving scorers can be found via the draft and brought into the rotation if the offense is staggering.

player	pos	tm	V1	yr
Trevor Ariza	SF	WAS	5	2019
Zach Collins	C	POR	7	2019
Mario Hezonja	SF	NYK	4	2019
Rodney Hood	SG	CLE	5	2019
Damian Lillard	PG	POR	1	2019
CJ McCollum	SG	POR	5	2019
Jusuf Nurkić	C	POR	6	2019
Hassan Whiteside	C	MIA	6	2019

**V1 = Cluster*

References:

<https://www.cbssports.com/nba/news/2020-nba-free-agency-top-30-players-in-next-years-class-led-by-anthony-davis-demar-derozan-brandon-ingram/>

Winston, W. 2012. *Mathletics: How Gamblers, Managers, and Sports Enthusiasts Use Mathematics in Baseball, Basketball, and Football*. Princeton, NJ.: Princeton Press.

Appendix A – Portland Trailblazers Four Factors Model

	Team	W	L	Off_eFG.	Def_eFG.	OEFGrank	DEFGrank	year
6	Portland Trail Blazers*	53	29	0.528	0.516	11	14	2019
16	Portland Trail Blazers	23	28	0.523	0.519	14	16	2020

	Team	W	L	Off_TOV.	Def_TOV.	OTOVrank	DTOVrank	year
6	Portland Trail Blazers*	53	29	12.1	11.0	12	22	2019
16	Portland Trail Blazers	23	28	11.4	10.9	19	20	2020

	Team	W	L	Off_ORB.	Def_DRB.	ORBrank	DRBrank	year
6	Portland Trail Blazers*	53	29	26.6	77.9	1	8	2019
16	Portland Trail Blazers	23	28	22.1	75.0	17	20	2020

	Team	W	L	Off_FT.FGA	Def_FT.FGA	OFTrank	DFTrank	year
6	Portland Trail Blazers*	53	29	0.210	0.195	7	14	2019
16	Portland Trail Blazers	23	28	0.194	0.205	15	12	2020

Appendix B – Portland Rebounding Production

2019 Rebounding:

player	pos	age	mp	orb	drb	trb	pts
Al-Farouq Aminu	PF	28	28.3	1.4	6.1	7.5	9.4
Wade Baldwin	PG	22	5.9	0.1	0.8	0.9	1.9
Zach Collins	C	21	17.6	1.4	2.8	4.2	6.6
Seth Curry	SG	28	18.9	0.4	1.3	1.6	7.9
Maurice Harkless	SF	25	23.6	1.3	3.2	4.5	7.7
Rodney Hood	SG	26	24.4	0.3	1.4	1.7	9.6
Enes Kanter	C	26	22.3	3.7	4.9	8.6	13.1
Skal Labissière	PF	22	7.0	0.6	1.6	2.1	3.4
Jake Layman	SF	24	18.7	0.8	2.3	3.1	7.6
Meyers Leonard	C	26	14.4	0.8	3.0	3.8	5.9
Damian Lillard	PG	28	35.5	0.9	3.8	4.6	25.8
CJ McCollum	SG	27	33.9	0.9	3.1	4.0	21.0
Jusuf Nurkić	C	24	27.4	3.4	7.0	10.4	15.6
Anfernee Simons	SG	19	7.1	0.2	0.5	0.7	3.8
Nik Stauskas	SG	25	15.3	0.2	1.6	1.8	6.1
Caleb Swanigan	PF	21	8.1	0.7	2.2	2.9	1.9
Gary Trent	SG	20	7.4	0.1	0.7	0.7	2.7
Evan Turner	PG	30	22.0	0.5	4.0	4.5	6.8

2020 Rebounding:

player	pos	age	mp	orb	drb	trb	pts
Carmelo Anthony	PF	35	32.5	1.3	5.3	6.6	15.1
Trevor Ariza	SF	34	31.5	0.6	3.9	4.5	10.1
Kent Bazemore	SF	30	25.8	0.3	3.7	4.0	7.9
Moses Brown	C	20	3.7	0.3	1.2	1.6	1.2
Zach Collins	PF	22	28.7	1.3	2.7	4.0	9.0
Wenyen Gabriel	PF	22	8.1	0.4	0.9	1.3	2.0
Mario Hezonja	PF	24	16.2	0.6	3.0	3.6	4.5
Jaylen Hoard	SF	20	7.9	1.1	1.4	2.5	2.9
Rodney Hood	SF	27	29.5	0.5	3.0	3.4	11.0
Skal Labissière	C	23	17.2	2.0	3.2	5.1	5.8
Damian Lillard	PG	29	37.0	0.5	3.8	4.4	29.5
Nassir Little	PF	19	12.7	0.7	1.8	2.5	3.8
CJ McCollum	SG	28	35.7	0.6	3.3	3.9	21.3
Anfernee Simons	SG	20	22.2	0.4	2.1	2.5	9.1
Caleb Swanigan	PF	22	16.0	1.7	3.8	5.5	3.2
Anthony Tolliver	PF	34	16.8	0.8	2.5	3.3	3.9
Gary Trent	SG	21	17.8	0.4	1.1	1.5	6.8
Hassan Whiteside	C	30	30.8	4.0	10.1	14.1	15.7

Appendix C – Games Won Regression

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Call:
lm(formula = W ~ EFG + TOV + RB + FT_FGA, data = data.train)

Residuals:
    Min       1Q   Median       3Q      Max
-8.0210 -3.0327 -0.5344  2.8348  8.6109

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  86.5501    29.6953   2.915  0.0066
EFG         419.0513    46.6675  8.980  0.00000732
TOV          -2.7878     0.8909  -3.129  0.00611
RB             0.8349     0.5481   1.523  0.14609
FT_FGA       98.7707    54.3328   1.818  0.08675

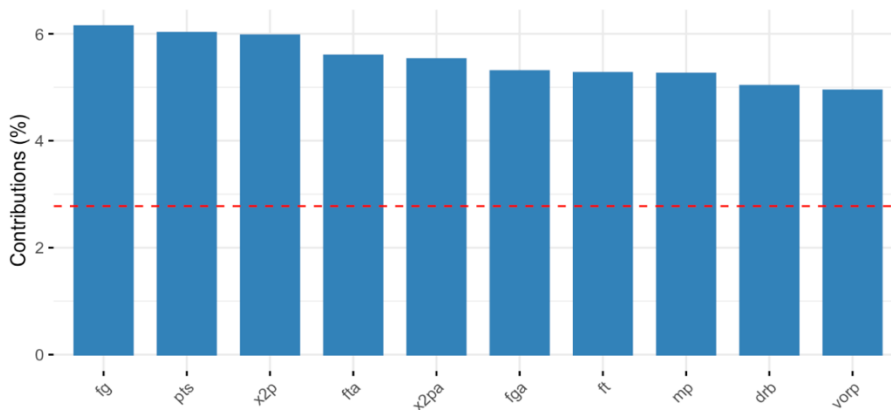
Residual standard error: 4.979 on 17 degrees of freedom
Multiple R-squared:  0.8407,    Adjusted R-squared:  0.8032
F-statistic: 22.43 on 4 and 17 DF,  p-value: 0.00001348
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Appendix D – PCA

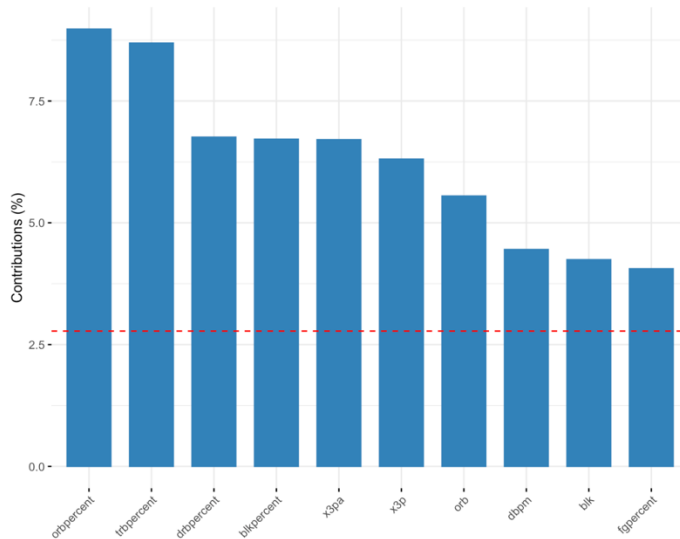
36 Variables used: MP, FG, FGA, FGPERCENT, X3P, X3PA, X3PPERCENT, X2P, X2PA, X2PPERCENT, EFGPERCENT, FT, FTA, FTPERCENT, ORG, DRB, TRB, AST, STL, BLK, TOV, PF, PTS, TSPERCENT, FTR, ORBPERCENT, DRBPERCENT, TRBPERCENT, ASTPERCENT, STLPERCENT, BLKPERCENT, TOVPERCENT, OBPM, DBPM, BPM, VORP

PCA Plots:

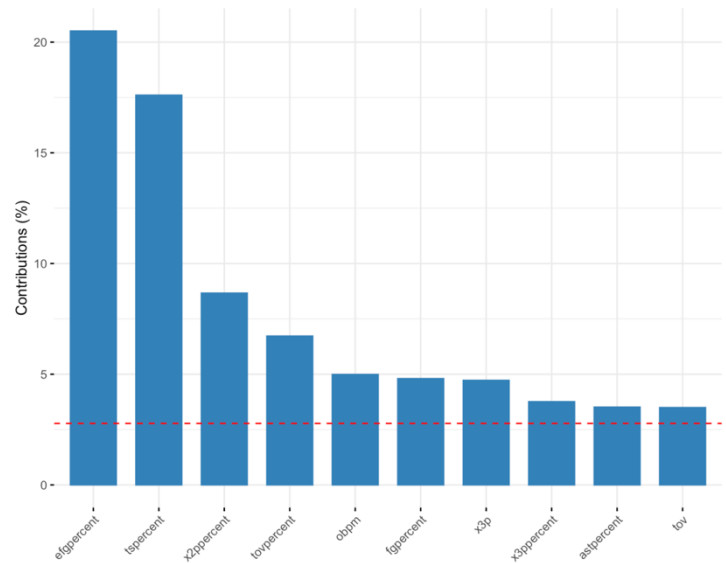
Contribution of variables to Dim-1

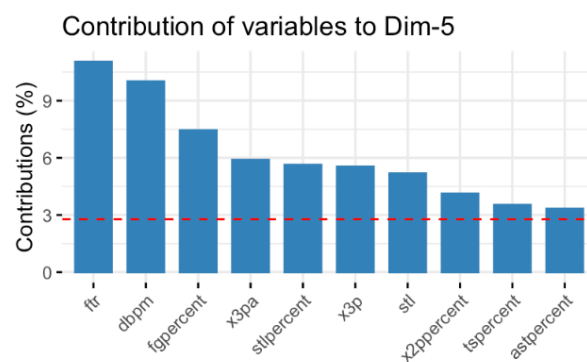
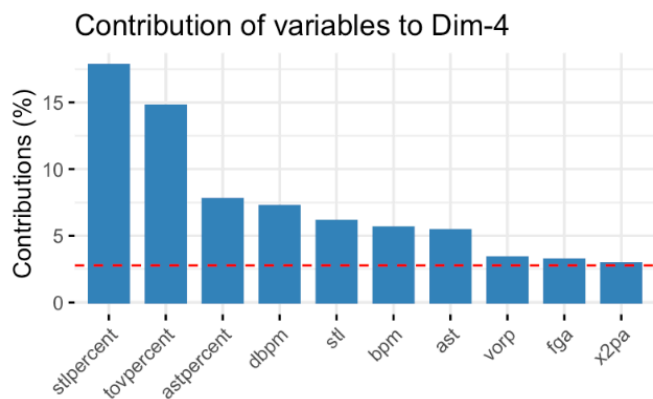


Contribution of variables to Dim-2



Contribution of variables to Dim-3





Appendix E – K-means optimal cluster (7)

