Redefining NBA Positions -Clustering Analysis based on Player Shooting Style

Xudong Liang (Brandon)

Davidson College '2017

About me
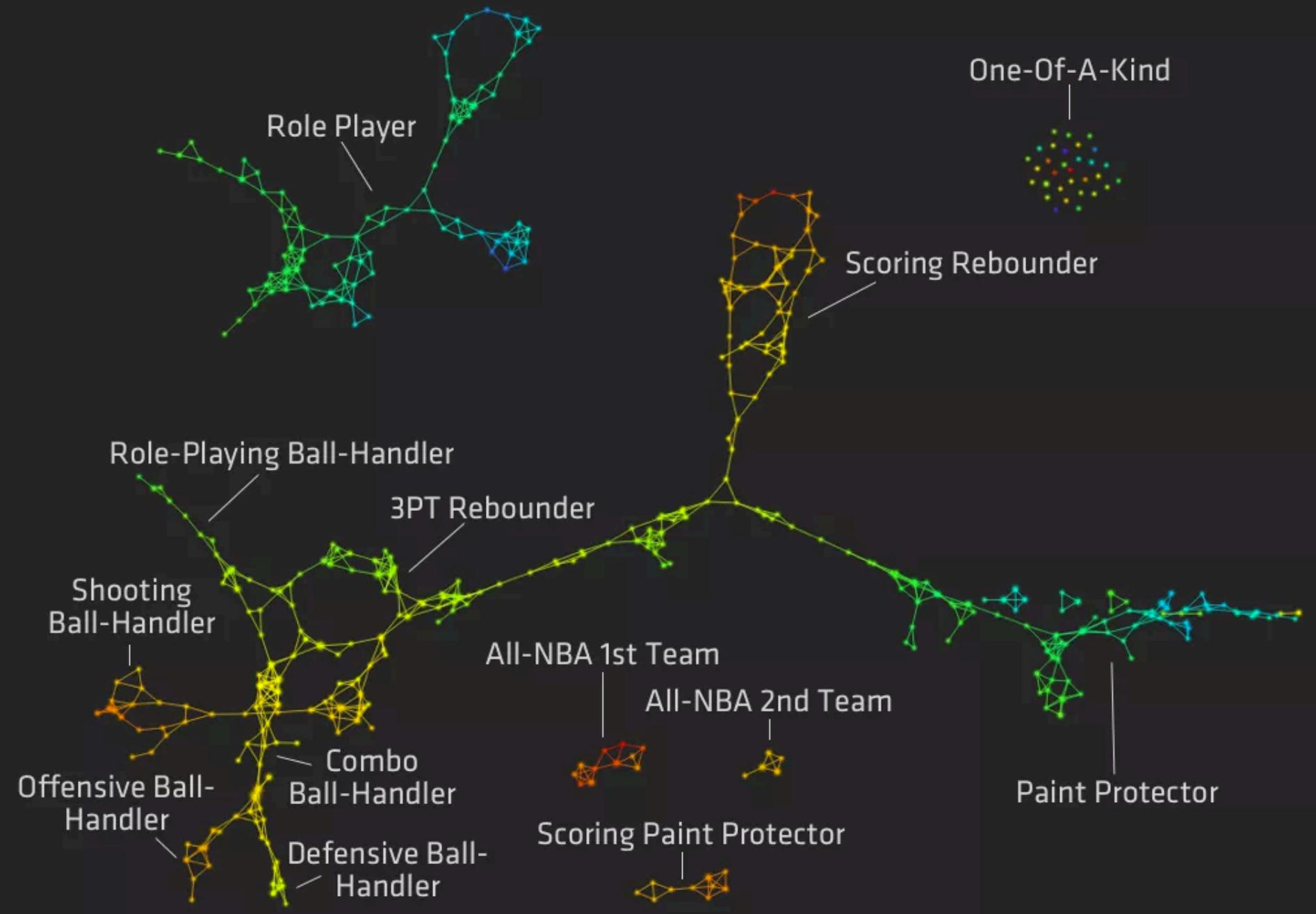
- Xudong Liang, Brandon

- Davidson College '2017

- Math Major, Computer Science Minor

- Basketball

- Charlotte Hornets

- Sports and Data Analytics

Inspiration

- Myth of "Position"
  - Height/Size vs Position
  - PG or SG: Allen Iverson
  - SG vs SF?
  - PF: Draymond Green over David Lee
  - NBA Going Small

- Evolution of Basketball Positioning
  - The traditional 5-position categorization can no longer suffice the evolving dynamics of the NBA, especially in terms of shooting.

Works Done By Others

- <Redefining NBA Positions> @MIT Sloan Conference
  - Muthu Alagappan
  - https://flowingdata.com/2012/03/21/redefining-nba-basketball-positions/

- "But what if we were wrong about our initial five positions. Maybe a Center is just a label for people over a certain height, and there are actually 3 types of big men in the NBA."

One-Of-A-Kind

Role Player

Scoring Rebounder

Role-Playing Ball-Handler

3PT Rebounder

Shooting Ball-Handler

All-NBA 1st Team

All-NBA 2nd Team

Offensive Ball-Handler

Combo Ball-Handler

Defensive Ball-Handler

Scoring Paint Protector

Paint Protector

Brain Storm

- Goal:
    - A more detailed categorization-clustering for players

- My Thoughts:
    - Cluster within "Position"
        - Fundamental Differences between "Positions"
        - "Boundary" between "Positions"
    - Focus: Shooting
        - Care about: How each player plays/shoots
        - Not care about: How well each player plays/shoots
        - Nutshell: Shooting Style

- Adjusted Goal:
    - Clustering players within each "Position" based on Shooting Style

Methodology

- Breaking Down each Player's Shot Distribution by Range:
  - 0 to 12 feet: Paint
  - 12 to 24 feet: Mid-Range
  - 24 feet and beyond: 3 Pointer (22 Feet actually)*

- Feature

Data

- <How to Create NBA Shot Chart in Python>
  - By Savvas Tjortjoglou

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1	9	58	Missed Shot	Jump Shot	3PT Field Goal	Right Corner	Right Side(R)	24+ ft.	22	226	39	1	0
1	8	25	Missed Shot	Layup Shot	2PT Field Goal	Restricted Ar	Center(C)	Less Than 8 ft.	2	-15	15	1	0
1	8	21	Made Shot	Jump Shot	3PT Field Goal	Above the Br	Left Side Cen	24+ ft.	25	-232	110	1	1
1	4	32	Missed Shot	Jump Shot	2PT Field Goal	Mid-Range	Left Side Cen	16-24 ft.	19	-146	135	1	0
1	2	38	Made Shot	Driving Layup Shot	2PT Field Goal	Restricted Ar	Center(C)	Less Than 8 ft.	2	-8	22	1	1
2	8	31	Missed Shot	Jump Shot	3PT Field Goal	Above the Br	Center(C)	24+ ft.	25	-46	246	1	0
2	5	49	Made Shot	Step Back Jump shot	3PT Field Goal	Above the Br	Center(C)	24+ ft.	24	-21	249	1	1
2	4	42	Made Shot	Jump Shot	3PT Field Goal	Above the Br	Right Side Ce	24+ ft.	24	181	165	1	1
2	4	10	Missed Shot	Jump Shot	2PT Field Goal	Mid-Range	Right Side Ce	16-24 ft.	20	69	189	1	0
2	2	48	Made Shot	Driving Layup Shot	2PT Field Goal	Restricted Ar	Center(C)	Less Than 8 ft.	2	-18	11	1	1
2	2	11	Missed Shot	Fadeaway Jump Shot	2PT Field Goal	Mid-Range	Right Side(R)	16-24 ft.	17	174	36	1	0
2	1	8	Missed Shot	Fadeaway Jump Shot	2PT Field Goal	Mid-Range	Right Side(R)	16-24 ft.	16	162	14	1	0
2	0	0	Missed Shot	Layup Shot	2PT Field Goal	Restricted Ar	Center(C)	Less Than 8 ft.	1	-13	7	1	0
3	7	21	Missed Shot	Jump Shot	2PT Field Goal	Mid-Range	Center(C)	16-24 ft.	17	-46	173	1	0
3	6	8	Made Shot	Driving Layup Shot	2PT Field Goal	Restricted Ar	Center(C)	Less Than 8 ft.	1	10	7	1	1
3	2	35	Made Shot	Driving Layup Shot	2PT Field Goal	Restricted Ar	Center(C)	Less Than 8 ft.	1	-4	15	1	1
3	0	31	Missed Shot	Jump Shot	3PT Field Goal	Above the Br	Left Side Cen	24+ ft.	25	-108	227	1	0
1	8	49	Missed Shot	Jump Shot	2PT Field Goal	In The Paint	Center(C)	Less Than 8 ft.	4	-10	42	1	0
1	4	24	Missed Shot	Jump Shot	2PT Field Goal	Mid-Range	Left Side(L)	16-24 ft.	20	-209	11	1	0
1	4	3	Made Shot	Layup Shot	2PT Field Goal	Restricted Ar	Center(C)	Less Than 8 ft.	1	-19	1	1	1
1	3	39	Missed Shot	Jump Shot	2PT Field Goal	In The Paint	Center(C)	8-16 ft.	8	4	89	1	0
1	2	45	Missed Shot	Jump Shot	2PT Field Goal	Restricted Ar	Center(C)	Less Than 8 ft.	3	24	23	1	0
2	6	8	Made Shot	Driving Layup Shot	2PT Field Goal	Restricted Ar	Center(C)	Less Than 8 ft.	2	12	19	1	1
2	3	45	Missed Shot	Driving Layup Shot	2PT Field Goal	Restricted Ar	Center(C)	Less Than 8 ft.	3	-32	22	1	0
2	1	40	Missed Shot	Running Jump Shot	2PT Field Goal	In The Paint	Center(C)	Less Than 8 ft.	5	-48	22	1	0
2	1	12	Made Shot	Jump Shot	2PT Field Goal	Mid-Range	Center(C)	16-24 ft.	18	-54	181	1	1
2	0	0	Made Shot	Jump Shot	3PT Field Goal	Above the Br	Right Side Ce	24+ ft.	24	155	194	1	1
3	9	43	Missed Shot	Fadeaway Jump Shot	2PT Field Goal	Mid-Range	Right Side(R)	8-16 ft.	15	157	-24	1	0
3	7	16	Missed Shot	Jump Shot	3PT Field Goal	Above the Br	Right Side Ce	24+ ft.	24	81	233	1	0
3	5	31	Missed Shot	Jump Shot	3PT Field Goal	Above the Br	Right Side Ce	24+ ft.	24	125	209	1	0
3	2	36	Missed Shot	Jump Shot	2PT Field Goal	Mid-Range	Left Side Cen	16-24 ft.	17	-131	112	1	0
4	7	27	Missed Shot	Jump Shot	3PT Field Goal	Above the Br	Left Side Cen	24+ ft.	24	-149	194	1	0
4	5	45	Made Shot	Fadeaway Jump Shot	2PT Field Goal	Mid-Range	Right Side(R)	16-24 ft.	19	193	-8	1	1
4	3	42	Missed Shot	Jump Shot	3PT Field Goal	Above the Br	Right Side Ce	24+ ft.	24	103	220	1	0

PERIOD	MINUTES_REMAINING	SECONDS_REMAINING	EVENT_TYPE	ACTION_TYP	SHOT_TYPE	SHOT_ZONE	SHOT_ZONE	SHOT_ZONE_RANGE	SHOT_DISTANCE	LOC_X	LOC_Y	SHOT_ATTEMPTED_FLAG	SHOT_MADE_FLAG
1	9	58	Missed Shot	Jump Shot	3PT Field Goal	Right Corner	Right Side(R)	24+ ft.	22	226	39	1	0
1	8	25	Missed Shot	Layup Shot	2PT Field Goal	Restricted Ar	Center(C)	Less Than 8 ft.	2	-15	15	1	0
1	8	21	Made Shot	Jump Shot	3PT Field Goal	Above the Br	Left Side Cen	24+ ft.	25	-232	110	1	1
1	4	32	Missed Shot	Jump Shot	2PT Field Goal	Mid-Range	Left Side Cen	16-24 ft.	19	-146	135	1	0
1	2	38	Made Shot	Driving Layu	2PT Field Goal	Restricted Ar	Center(C)	Less Than 8 ft.	2	-8	22	1	1
2	8	31	Missed Shot	Jump Shot	3PT Field Goal	Above the Br	Center(C)	24+ ft.	25	-46	246	1	0
2	5	49	Made Shot	Step Back Ju	3PT Field Goal	Above the Br	Center(C)	24+ ft.	24	-21	249	1	1
2	4	42	Made Shot	Jump Shot	3PT Field Goal	Above the Br	Right Side Ce	24+ ft.	24	181	165	1	1
2	4	10	Missed Shot	Jump Shot	2PT Field Goal	Mid-Range	Right Side Ce	16-24 ft.	20	69	189	1	0
2	2	48	Made Shot	Driving Layu	2PT Field Goal	Restricted Ar	Center(C)	Less Than 8 ft.	2	-18	11	1	0
2	2	11	Missed Shot	Fadeaway Ju	2PT Field Goal	Mid-Range	Right Side(R)	16-24 ft.	17	174	36	1	0
2	1	8	Missed Shot	Fadeaway Ju	2PT Field Goal	Mid-Range	Right Side(R)	16-24 ft.	16	162	14	1	0
2	0	0	Missed Shot	Layup Shot	2PT Field Goal	Restricted Ar	Center(C)	Less Than 8 ft.	1	-13	7	1	0
3	7	21	Missed Shot	Jump Shot	2PT Field Goal	Mid-Range	Center(C)	16-24 ft.	17	-46	173	1	0
3	6	8	Made Shot	Driving Layu	2PT Field Goal	Restricted Ar	Center(C)	Less Than 8 ft.	1	10	7	1	1
3	2	35	Made Shot	Driving Layu	2PT Field Goal	Restricted Ar	Center(C)	Less Than 8 ft.	1	-4	15	1	1
3	0	31	Missed Shot	Jump Shot	3PT Field Goal	Above the Br	Left Side Cen	24+ ft.	25	-108	227	1	0
1	8	49	Missed Shot	Jump Shot	2PT Field Goal	In The Paint	Center(C)	Less Than 8 ft.	4	-10	42	1	0
1	4	24	Missed Shot	Jump Shot	2PT Field Goal	Mid-Range	Left Side(L)	16-24 ft.	20	-209	11	1	0
1	4	3	Made Shot	Layup Shot	2PT Field Goal	Restricted Ar	Center(C)	Less Than 8 ft.	1	-19	1	1	1
1	3	39	Missed Shot	Jump Shot	2PT Field Goal	In The Paint	Center(C)	8-16 ft.	8	4	89	1	0
1	2	45	Missed Shot	Jump Shot	2PT Field Goal	Restricted Ar	Center(C)	Less Than 8 ft.	3	24	23	1	0
2	6	8	Made Shot	Driving Layu	2PT Field Goal	Restricted Ar	Center(C)	Less Than 8 ft.	2	12	19	1	1
2	3	45	Missed Shot	Driving Layu	2PT Field Goal	Restricted Ar	Center(C)	Less Than 8 ft.	3	-32	22	1	0
2	1	40	Missed Shot	Running Jum	2PT Field Goal	In The Paint	Center(C)	Less Than 8 ft.	5	-48	22	1	0
2	1	12	Made Shot	Jump Shot	2PT Field Goal	Mid-Range	Center(C)	16-24 ft.	18	-54	181	1	1
2	0	0	Made Shot	Jump Shot	3PT Field Goal	Above the Br	Right Side Ce	24+ ft.	24	155	194	1	1
3	9	43	Missed Shot	Fadeaway Ju	2PT Field Goal	Mid-Range	Right Side(R)	8-16 ft.	15	157	-24	1	0
3	7	16	Missed Shot	Jump Shot	3PT Field Goal	Above the Br	Right Side Ce	24+ ft.	24	81	233	1	0
3	5	31	Missed Shot	Jump Shot	3PT Field Goal	Above the Br	Right Side Ce	24+ ft.	24	125	209	1	0
3	2	36	Missed Shot	Jump Shot	2PT Field Goal	Mid-Range	Left Side Cen	16-24 ft.	17	-131	112	1	0
4	7	27	Missed Shot	Jump Shot	3PT Field Goal	Above the Br	Left Side Cen	24+ ft.	24	-149	194	1	0
4	5	45	Made Shot	Fadeaway Ju	2PT Field Goal	Mid-Range	Right Side(R)	16-24 ft.	19	193	-8	1	1
4	3	42	Missed Shot	Jump Shot	3PT Field Goal	Above the Br	Right Side Ce	24+ ft.	24	103	220	1	0

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Data

Player	Team	0-12 Attempt%	12-24 Attempt%	>=24 Attempt%	Attempt/Minute
James Harden 2	['HOU']	0.4429	0.3456	0.2116	0.493156

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Harden",1610612745,"Houston Rockets",1,9,58,"Missed Shot","Jump Shot","3PT Field Goal","Right Corner 3","Right Side(R)","24+ ft.",22,226,39,1,0],["Shot Chart Detail","0021400003",39,201935,"James Harden",1610612745,"Houston Rockets",1,8,25,"Missed Shot","Layup Shot","2PT Field Goal","Restricted Area","Center(C)","Less Than 8 ft.",2,-15,15,1,0],["Shot Chart Detail","0021400003",41,201935,"James Harden",1610612745,"Houston Rockets",1,8,21,"Made Shot","Jump Shot","3PT Field Goal","Above the Break 3","Left Side Center(LC)","24+ ft.",25,-232,110,1,1],["Shot Chart Detail","0021400003",95,201935,"James Harden",1610612745,"Houston Rockets",1,4,32,"Missed Shot","Jump Shot","2PT Field Goal","Mid-Range","Left Side Center(LC)","16-24 ft.",19,-146,135,1,0],["Shot Chart Detail","0021400003",120,201935,"James Harden",1610612745,"Houston Rockets",1,2,38,"Made Shot","Driving Layup Shot","2PT Field Goal","Restricted Area","Center(C)","Less Than 8 ft.",2,-8,22,1,1],["Shot Chart Detail","0021400003",214,201935,"James Harden",1610612745,"Houston Rockets",2,8,31,"Missed Shot","Jump Shot","3PT Field Goal","Above the Break 3","Center(C)","24+ ft.",25,-46,246,1,0],["Shot Chart Detail","0021400003",241,201935,"James Harden",1610612745,"Houston Rockets",2,5,49,"Made Shot","Step Back Jump shot","3PT Field Goal","Above the Break 3","Center(C)","24+ ft.",24,-21,249,1,1],["Shot Chart Detail","0021400003",252,201935,"James Harden",1610612745,"Houston Rockets",2,4,42,"Made Shot","Jump Shot","3PT Field Goal","Above the Break 3","Right Side Center(RC)","24+ ft.",24,181,165,1,1],["Shot Chart Detail","0021400003",254,201935,"James Harden",1610612745,"Houston Rockets",2,4,10,"Missed Shot","Jump Shot","2PT Field Goal","Mid-Range","Right Side Center(RC)","16-24 ft.",20,69,189,1,0],["Shot Chart Detail","0021400003",272,201935,"James Harden",1610612745,"Houston Rockets",2,2,48,"Made Shot","Driving Layup Shot","2PT Field Goal","Restricted Area","Center(C)","Less Than 8 ft.",2,-18,11,1,1],["Shot Chart Detail","0021400003",279,201935,"James Harden",1610612745,"Houston Rockets",2,2,11,"Missed Shot","Fadeaway Jump Shot","2PT Field Goal","Mid-Range","Right Side(R)","16-24 ft.",17,174,36,1,0],["Shot Chart Detail","0021400003",300,201935,"James Harden",1610612745,"Houston Rockets",2,1,8,"Missed Shot","Fadeaway Jump Shot","2PT Field Goal","Mid-Range","Right Side(R)","16-24 ft.",16,162,14,1,0],["Shot Chart Detail","0021400003",318,201935,"James Harden",1610612745,"Houston Rockets",2,0,0,"Missed Shot","Layup Shot","2PT Field Goal","Restricted Area","Center(C)","Less Than 8 ft.",1,-13,7,1,0],["Shot Chart Detail","0021400003",385,201935,"James Harden",1610612745,"Houston Rockets",3,7,21,"Missed Shot","Jump Shot","2PT Field Goal","Mid-Range","Center(C)","16-24 ft.",17,-46,173,1,0],["Shot Chart Detail","0021400003",409,201935,"James Harden",1610612745,"Houston Rockets",3,6,8,"Made Shot","Driving Layup Shot","2PT Field Goal","Restricted Area","Center(C)","Less Than 8 ft.",1,10,7,1,1],["Shot Chart Detail","0021400003",456,201935,"James Harden",1610612745,"Houston Rockets",3,2,35,"Made Shot","Driving Layup Shot","2PT Field Goal","Restricted Area","Center(C)","Less Than 8 ft.",1,-4,15,1,1],["Shot Chart Detail","0021400003",481,201935,"James Harden",1610612745,"Houston Rockets",3,0,31,"Missed Shot","Jump Shot","3PT Field Goal","Above the Break 3","Left Side Center(LC)","24+ ft.",25,-108,227,1,0],["Shot Chart Detail","0021400012",25,201935,"James Harden",1610612745,"Houston Rockets",1,8,49,"Missed Shot","Jump Shot","2PT Field Goal","In The Paint (Non-RA)","Center(C)","Less Than 8 ft.",4,-10,42,1,0],["Shot Chart Detail","0021400012",51,201935,"James Harden",1610612745,"Houston Rockets",1,4,24,"Missed Shot","Jump Shot","2PT Field Goal","Mid-Range","Left Side(L)","16-24 ft.",20,-209,11,1,0],["Shot Chart Detail","0021400012",55,201935,"James Harden",1610612745,"Houston Rockets",1,4,3,"Made Shot","Layup Shot","2PT Field Goal","Restricted Area","Center(C)","Less Than 8 ft.",1,-19,1,1,1],["Shot Chart Detail","0021400012",62,201935,"James Harden",1610612745,"Houston Rockets",1,3,39,"Missed Shot","Jump Shot","2PT Field Goal","In The Paint (Non-RA)","Center(C)","8-16 ft.",8,4,89,1,0],["Shot Chart Detail","0021400012",73,201935,"James Harden",1610612745,"Houston Rockets",1,2,45,"Missed Shot","Jump Shot","2PT Field Goal","Restricted Area","Center(C)","Less Than 8 ft.",3,24,23,1,0],["Shot Chart Detail","0021400012",147,201935,"James Harden",1610612745,"Houston Rockets",2,6,8,"Made Shot","Driving Layup Shot","2PT Field Goal","Restricted Area","Center(C)","Less Than 8 ft.",2,12,19,1,1],["Shot Chart Detail","0021400012",165,201935,"James Harden",1610612745,"Houston Rockets",2,3,45,"Missed Shot","Driving Layup Shot","2PT Field Goal","Restricted Area","Center(C)","Less Than 8 ft.",3,-32,22,1,0],["Shot Chart Detail","0021400012",188,201935,"James Harden",1610612745,"Houston Rockets",2,1,40,"Missed Shot","Running Jump Shot","2PT Field Goal","In The Paint (Non-RA)","Center(C)","Less Than 8 ft.",5,-48,22,1,0],["Shot Chart Detail","0021400012",198,201935,"James Harden",1610612745,"Houston Rockets",2,1,12,"Made Shot","Jump Shot","2PT Field Goal","Mid-Range","Center(C)","16-24 ft.",18,-54,181,1,1],["Shot Chart Detail","0021400012",204,201935,"James Harden",1610612745,"Houston Rockets",2,0,0,"Made Shot","Jump Shot","3PT Field Goal","Above the Break 3","Right Side Center(RC)","24+ ft.",24,155,194,1,1],["Shot Chart Detail","0021400012",227,201935,"James

Name
Lou Amundson-200811.csv
Alexis Ajinca-201582.csv
Gary Harris-203914.csv
Jeremy Lin-202391.csv
Paul George-202331.csv
Terrence Jones-203093.csv
D.J. Augustin-201571.csv
Derrick Favors-202324.csv
Jrue Holiday-201950.csv
Kendrick Perkins-2570.csv
Leandro Barbosa-2571.csv
Ed Davis-202334.csv
Nikola Mirotic-202703.csv
Shawne Williams-200761.csv
Victor Oladipo-203506.csv
Jose Juan Barea-200826.csv
Chandler Parsons-202718.csv
Chris Andersen-2365.csv
Greg Monroe-202328.csv
Mitch McGary-203956.csv
Shabazz Muhammad-203498.csv
Dwight Howard-2730.csv

Data

Player Shooting Style Analysis-C.csv

Player Shooting Style Analysis-PF.csv

Player Shooting Style Analysis-PG.csv

Player Shooting Style Analysis-SF.csv

Player Shooting Style Analysis-SG.csv

Player Shooting Style Analysis.csv

Open with Microsoft Excel

Player	Team	0-12 Attempt%	12-24 Attempt%	>=24 Attempt%	Attempt/Minute	Minute/Game
Randy Foye 2	['DEN']	0.1965	0.4453	0.3582	0.370507	21.7
Jodie Meeks 2	['DET']	0.3652	0.4213	0.2135	0.364754	24.4
Avery Bradley 2	['BOS']	0.2233	0.6364	0.1403	0.417234	31.5
Joe Johnson 2	['BRK']	0.4439	0.4195	0.1366	0.36712	34.9
Will Barton 2	['POR', 'DEN', 'TOT']	0.5949	0.289	0.1161	0.360131	16.9
Nik Stauskas 2	['SAC']	0.2804	0.4865	0.2331	0.263298	15.4
Shannon Brown 2	['MIA']	0.4737	0.3684	0.1579	0.213483	17.8
Jabari Brown 2	['LAL']	0.4294	0.3706	0.2	0.299243	29.9
Wesley Matthews 2	['POR']	0.2876	0.506	0.2064	0.371414	33.7
Sergey Karasev 2	['BRK']	0.4627	0.4328	0.1045	0.241703	16.8
Elijah Millsap 2	['UTA']	0.5	0.3739	0.1261	0.257047	19.7
O.J. Mayo 2	['MIL']	0.3552	0.465	0.1797	0.413106	23.9
Brandon Rush 2	['GSW']	0.2778	0.3889	0.3333	0.199557	8.2
Jimmy Butler 2	['CHI']	0.5033	0.4013	0.0954	0.362552	38.7
Courtney Lee 2	['MEM']	0.3235	0.5334	0.1431	0.272897	30.6
Jamal Crawford 2	['LAC']	0.2479	0.4946	0.2574	0.492834	26.6
Tyler Johnson 2	['MIA']	0.509	0.3473	0.1437	0.277593	18.8
Kentavious Caldwell-Pope 2	['DET']	0.3498	0.3735	0.2767	0.376307	31.5
Jordan Adams 2	['MEM']	0.5	0.3605	0.1395	0.345382	8.3
Kevin Martin 2	['MIN']	0.288	0.584	0.128	0.47981	33.4
Jason Richardson 2	['PHI']	0.2753	0.4045	0.3202	0.427782	21.9
Vander Blue 2	['LAL']	0.5	0.2	0.3	0.405405	37.0
James Young 2	['BOS']	0.1569	0.5686	0.2745	0.307507	10.7
Gary Neal 2	['MIN', 'TOT', 'CHO']	0.3022	0.4771	0.2207	0.421485	22.1
Troy Daniels 2	['CHO', 'HOU', 'TOT', 'MIN']	0.1091	0.4606	0.4303	0.417933	8.4
John Jenkins 2	['ATL']	0.1717	0.596	0.2323	0.332661	12.4

Data Limitations

- Missing Data due to "Player ID"
    - Kobe Bryant, Tim Duncan, etc.

- Data only indicative of
    - 2014-2015 Season
    - players' shooting style-Field Goal Attempt

Clustering

- Definition
  - Grouping a set of objects in such a way that objects in the same group (cluster) are more similar to each other than to those in other groups (clusters)
  - A set of objects: Players within each "Position"
  - Group/Cluster: What we want
  - "Similar":
    - Intuitively: Shoots similarly Over Each of the 3 Ranges
    - Mathematically: Euclidean Distance

Euclidean Distance

$$E(x, y) = \sqrt{\sum_{i=0}^{n}(x_i - y_i)^2}$$

- x, y: Any Pair of Data Points (Players)
- xi, yi: Features
- Features: 3 Percentages of Shot Distribution
- n = 3
- Euclidean Distance:
  - Measures the "closeness" between two data points based on their features
  - Similarity of Players' Shooting Styles

Unsupervised Clustering
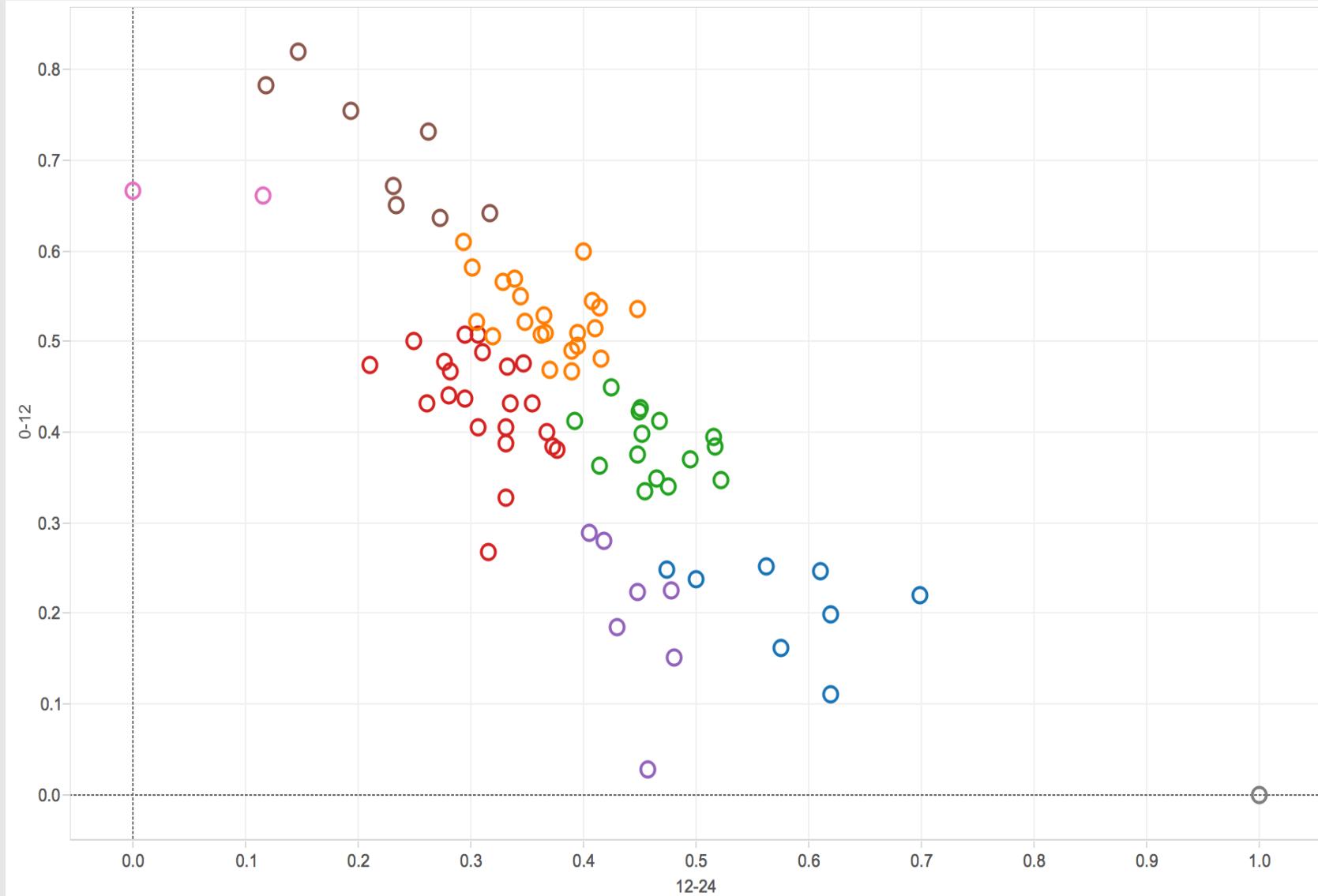
- Python's Scikit Library: sklearn.Cluster.Kmeans

- K = 8 for each position
  - My Arbitrary Choice

- Got 8 Clusters/Groups within each "Position"
  - Outlier Cluster
  - Manual Combination of Clusters
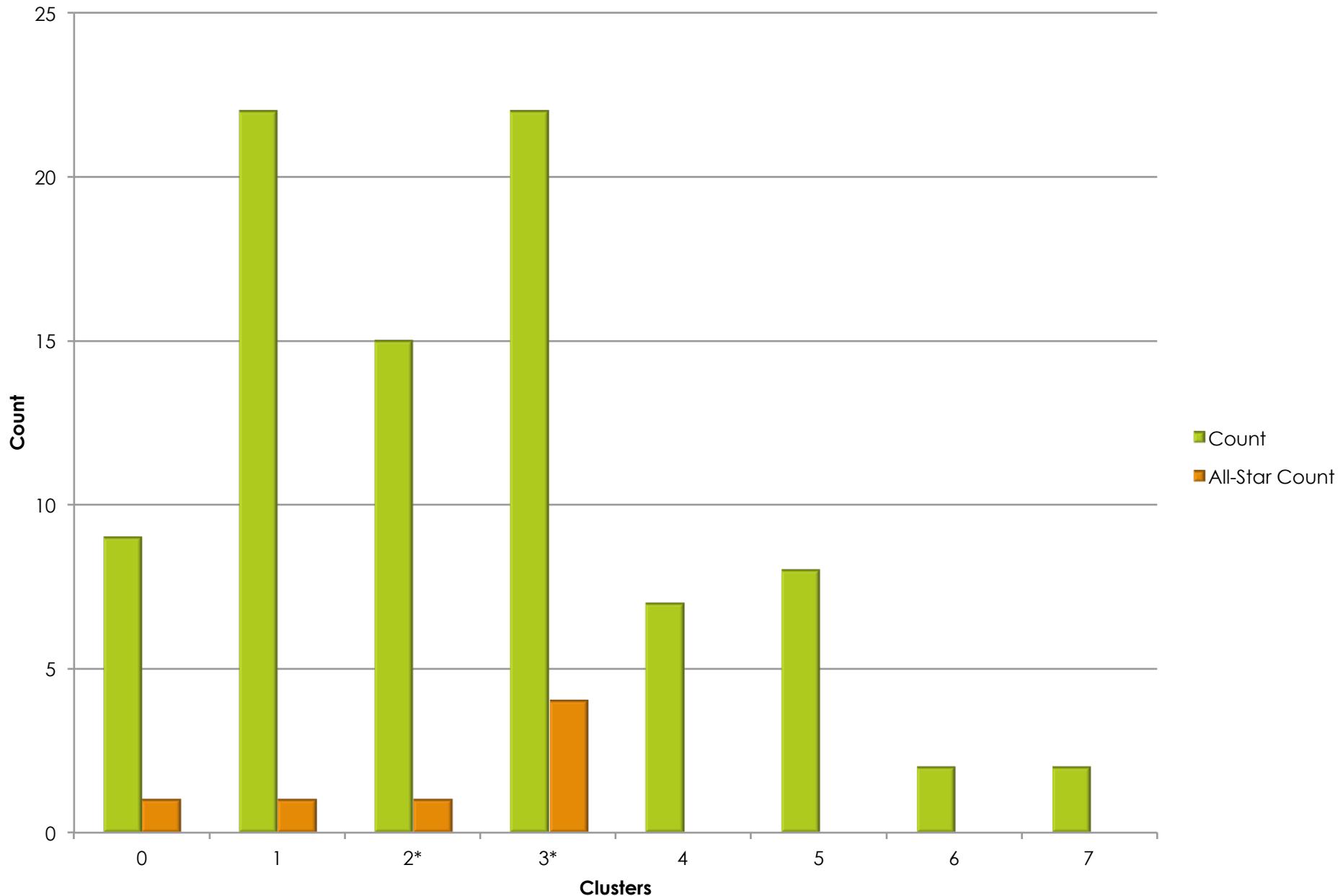
Result

- Point Guard: 8 Clusters (1 Outlier Cluster)

- Shooting Guard: 7 Clusters (1 Outlier Cluster, 1 Special Cluster)

- Small Forward: 6 Clusters

- Power Forward: 7 Clusters

- Center：7 Clusters

Point Guard

Cluster	0-12 %	12-24 %	>24 %	Count	All-Star	Interpretation	Key Players
0	0.2170	0.5779	0.2051	9	1	Mid-Range, >55%	Chris Paul
1	0.5279	0.3685	0.1036	22	1	Attacking, Paint (less) descending order, occasional 3	Tony Parker, Russell Westbrook
2*	0.3853	0.4627	0.1520	15	1	Balanced inside 3	John Wall
3*	0.4319	0.3120	0.2561	22	4	Balanced throughout! — **All-Star Caliber**	Curry, Lowry, Lillard, Irving
4	0.1977	0.4453	0.3570	7	0	Mid-Range >40%, 3 Pointer	Brian Roberts
5	0.7110	0.2216	0.0674	8	0	Attacking, Paint (more) descending order, barely 3	Shaun Livingston
6	0.6640	0.0576	0.2784	2	0	Paint (more) or 3, Barely Mid-Range	Tony Wroten
7	0.0000	1.0000	0.0000	2	0	Mid-Range--Outlier, small sample size of shots	Seth Curry
Mean	0.4281	0.3922	0.1797	Closest Cluster:	2,then 3		
StdDev	0.1659	0.1497	0.1023				
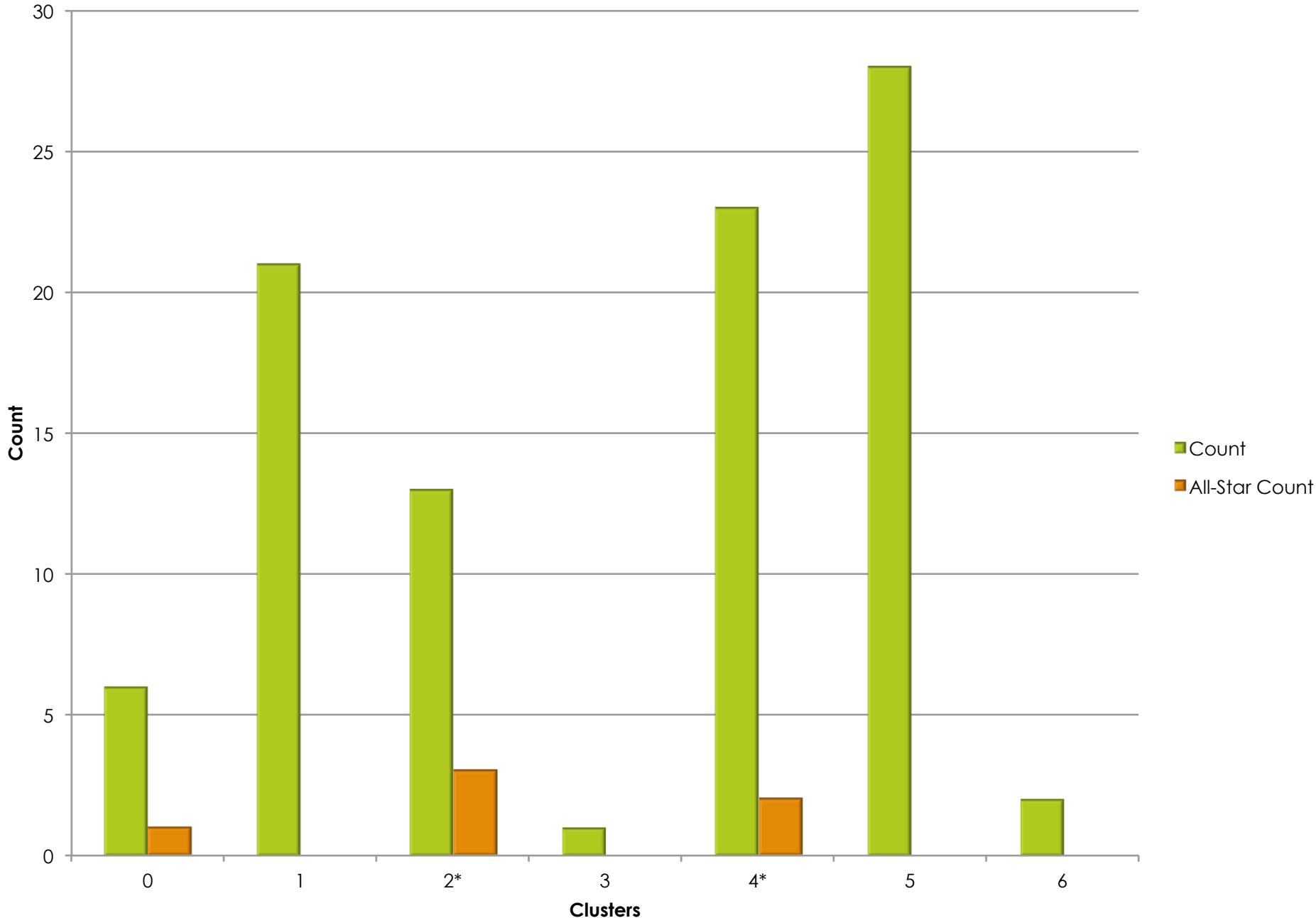
Point Guard Clusters Distribution

Shooting Guard

Cluster	0-12 %	12-24 %	>24 %	Count	All-Star	Interpretation	Key Players
0	0.1220	0.5030	0.3750	6	1	Jump shooter (Mid-Range and 3, Balanced, Barely Paint)	J.R Smith, Kyle Korver
1	0.5801	0.2957	0.1241	21	0	Attacking, In the paint	Andrew Wiggins, Victor Oladipo
2*	0.4544	0.4555	0.0901	13	3	Balanced inside 3 (Barely 3) -- **All-Star Caliber**	Wade, DeRozan, Butler
3	0.0000	0.0000	1.0000	1	0	Outlier: Small Sample/ Shot Size	Jamaal Franklin
4*	0.3637	0.3979	0.2384	23	2	Balanced, **--All-Star Caliber**	James Harden, Klay Thompson
5	0.2704	0.5332	0.1964	28	0	Mid-Range (=50%)	Jamal Crawford, Danny Green, Beal
6	0.9341	0.0572	0.0088	2	0	Tony-Allen Special	Tony Allen, Malcom Lee
Mean	0.3897	0.4186	0.1918	**Closest Cluster:**	**4, then 2**		
StdDev	0.1709	0.1251	0.1240				
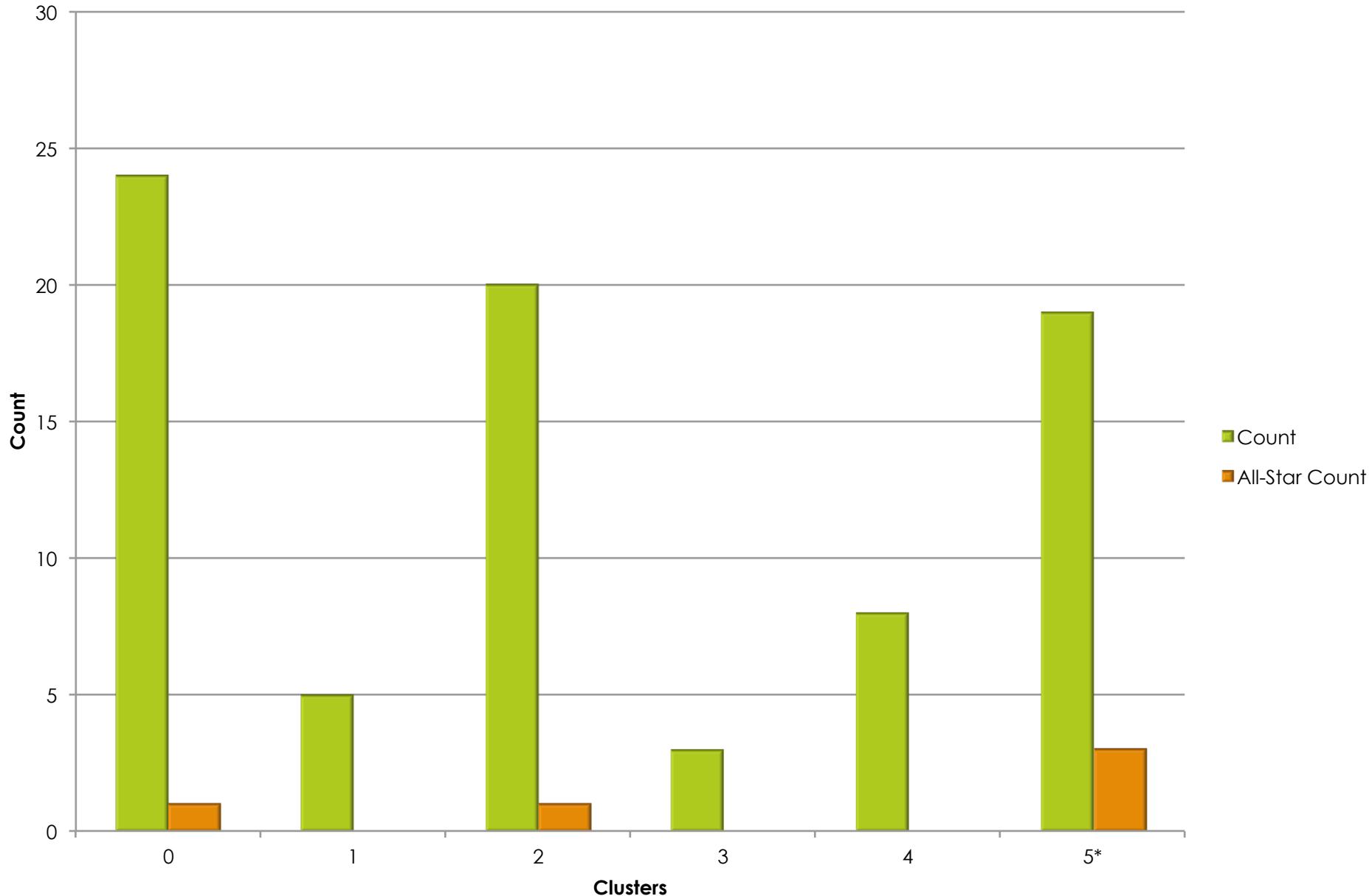
Shooting Guard Clusters Distribution

Small Forward

Cluster	0-12 %	12-24 %	>24 %	Count	All-Star	Interpretation	Key Players
0	0.2739	0.5287	0.1975	24	1	Mid-Range >42%	Paul George, Nicolas Batum
1	0.8127	0.1510	0.0362	5	0	Primarily in the paint	Landry Fields, Omri Casspi
2	0.5464	0.3271	0.1265	20	1	Most in the paint, then Mid-Range	LeBron James, MKG, Jabari Parker
3	0.3101	0.3049	0.3849	3	0	Balanced Jump Shooter (12~)	Robert Covington, Chris Copeland
4	0.1064	0.5006	0.3930	8	0	Outside Shooter (12~) Barely Paint	Mike Miller, Steve Novak, James Jones
5*	0.4376	0.4579	0.1045	19	3	Balanced inside 3, Occasionally 3 -- **All-Star Caliber**	Kevin Durant, Carmelo Anthony, Kawhi Leonard
Mean	0.4008	0.4254	0.1738	**Closest Cluster:**	**5**		
StdDev	0.1844	0.1248	0.1147				

Small Forward Clusters Distribution

PG vs SG vs SF by the Numbers

		0-12 %	12-24 %	>24 %
PG	Mean	0.4281	0.3922	0.1797
	StdDev	0.1659	0.1497	0.1023
SG	Mean	0.3897	0.4186	0.1918
	StdDev	0.1709	0.1251	0.1240
SF	Mean	0.4008	0.4254	0.1738
	StdDev	0.1844	0.1248	0.1147

PG vs SG

■ *Mid-Range Guards*

Cluster	0-12 %	12-24 %	>24 %	Count	Key Players
PG-0	0.2170	0.5779	0.2051	9	Chris Paul
SG-5	0.2704	0.5332	0.1964	28	Crawford, Beal

PG vs SF

■ Mid–Range

Cluster	0-12 %	12-24 %	>24 %	Count	Key Players
PG-0	0.2170	0.5779	0.2051	9	Chris Paul
SF-0	0.2739	0.5287	0.1975	24	George, Batum

■ Attacking

Cluster	0-12 %	12-24 %	>24 %	Count	Key Players
PG-1	0.5279	0.3685	0.1036	22	Westbrook, Parker
SF-2	0.5464	0.3271	0.1265	20	LeBron

SG vs SF

■ Mid–Range, Pull-up, Shooter

Cluster	0-12 %	12-24 %	>24 %	Count	Key Players
SG-5	0.2704	0.5332	0.1964	28	Crawford, Beal
SF-0	0.2739	0.5287	0.1975	24	George, Batum

■ Jump Shooter, Spot-up

Cluster	0-12 %	12-24 %	>24 %	Count	Key Players
SG-0	0.1220	0.5030	0.3750	6	J.R. Smith, Korver
SF-4	0.1064	0.5006	0.3930	8	Mike Miller, Novak

SG vs SF

■ Attacking

Cluster	0-12 %	12-24 %	>24 %	Count	Key Players
SG-1	0.5801	0.2957	0.1241	21	Wiggins, Oladipo
SF-2	0.5464	0.3271	0.1265	20	LeBron
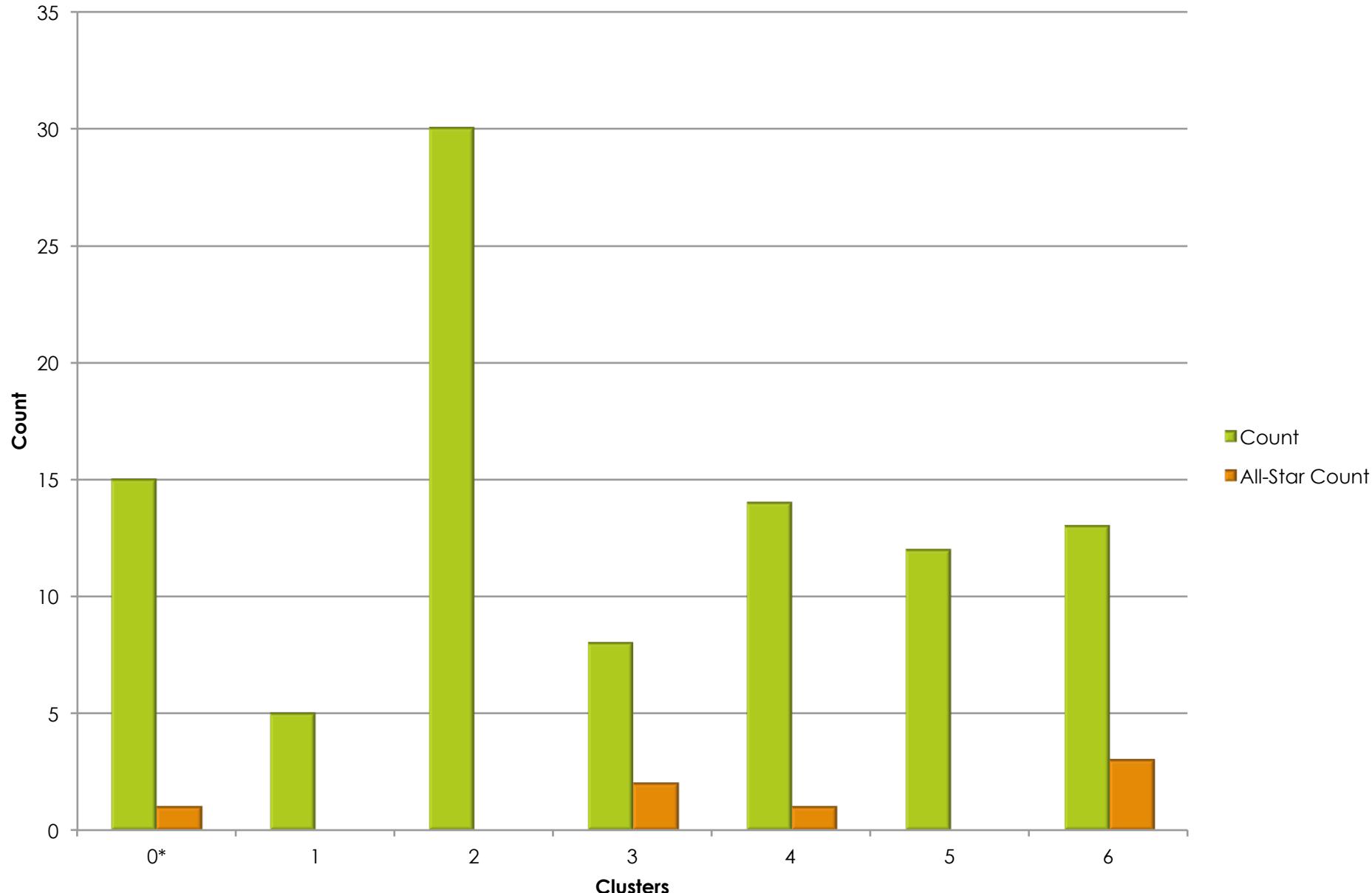
■ Pull-up, Play Maker ** All Star Caliber

Cluster	0-12 %	12-24 %	>24 %	Count	Key Players
SG-2	0.4544	0.4555	0.0901	13	Wade, DeRozan
SF-5	0.4376	0.4579	0.1045	19	Anthony, Durant

Power Forward

Cluster	0-12 %	12-24 %	>24 %	Count	All-Star	Interpretation	Key Players
0*	0.6638	0.2843	0.0519	15	1	Paint (>60%) Barely 3	Paul Millsap, Zach Randolph
1	0.2712	0.5764	0.1524	5	0	Mid-Range (>50%)	Darrell Arthur, Marcus Morris
2	0.8750	0.1083	0.0167	30	0	Paint Monster (>75%)	Tristan Thompson, Greg Monroe, Ed Davis
3	0.5154	0.3051	0.1796	8	2	Paint-Jump Shot Balanced, Versatile	Draymond Green, Kevin Love
4	0.4473	0.5196	0.0331	14	1	Balanced Inside 3 (Mid-Range=50%), Barely 3	LaMarcus Aldridge, Ibaka
5	0.3445	0.3896	0.2659	12	0	3 Point Shooter + Mid-Range, Stretch 4	Ryan Anderson, Matt Bonner
6	0.5693	0.4111	0.0195	13	3	Paint + Mid-Range, Barely 3, Skilled Scorer	Blake Griffin, Pau Gasol, AD
Mean	0.6132	0.3106	0.0762	Closest Cluster:	0		
StdDev	0.2145	0.1676	0.0960				

Power Forward Clusters Distribution

SF vs PF by the Numbers
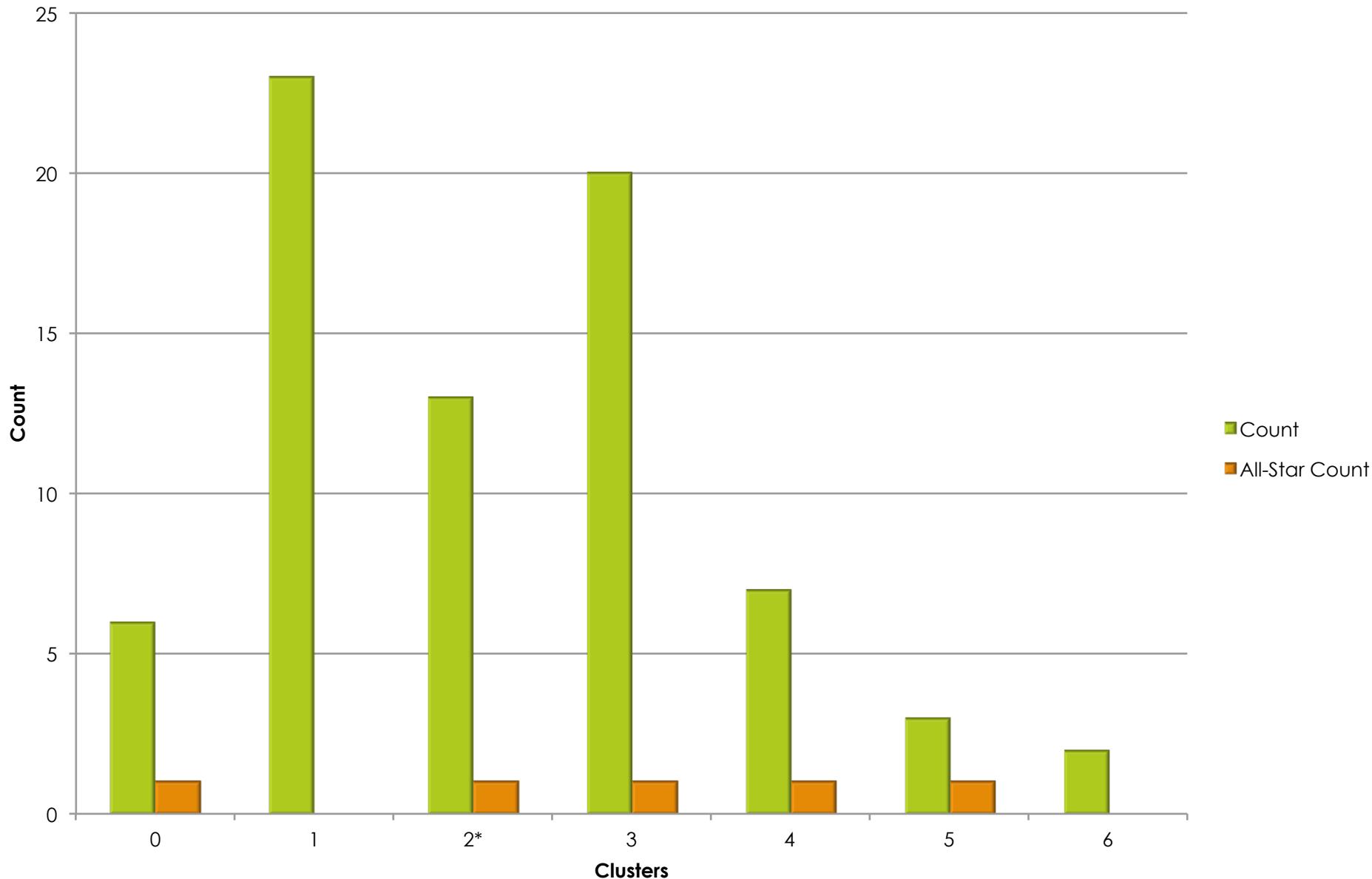
▫ Mobile, Attacking Wing/Big–All-Star Caliber?

Cluster	0-12 %	12-24 %	>24 %	Count	Key Players
SF-2	0.5464	0.3271	0.1265	20	LeBron
PF-3	0.5154	0.3051	0.1796	8	Love, Green

Center

Cluster	0-12 %	12-24 %	>24 %	Count	All-Star	Interpretation	Key Players
0	0.5071	0.4728	0.0201	6	1	Balanced inside 3	Al Horford
1	0.8707	0.1278	0.0015	23	0	Primarily Paint (Paint/ Mid-Range > 8/2), Barely 3	Hassan Whiteside, Joakim Noah
2*	0.7311	0.2610	0.0080	13	1	Paint/Mid-Range > 3/1, Barely 3, --All-Star Caliber	Cousins, Al Jefferson
3	0.9847	0.0134	0.0019	20	1	Paint Monster	Dwight, Jordan, Perkins
4	0.6302	0.3574	0.0124	7	1	Paint/Mid-Range 2/1~3/2, Barely 3	Marc Gasol, Cody Zeller
5	0.3691	0.5815	0.0494	3	1	Mid-Range Master	Chris Bosh
6	0.4476	0.3559	0.1966	2	0	Jump Shooting (3) C	Kelly Olynyk
Mean	0.7929	0.1945	0.0125	**Closest Cluster:**	**2**		
StdDev	0.1833	0.1673	0.0362				

Center Clusters Distribution

PF vs C by the Numbers

		0-12 %	12-24 %	>24 %
PF	Mean	0.6132	0.3106	0.0762
	StdDev	0.2145	0.1676	0.0960
C	Mean	0.7929	0.1945	0.0125
	StdDev	0.1833	0.1673	0.0362

PF vs C by the Numbers
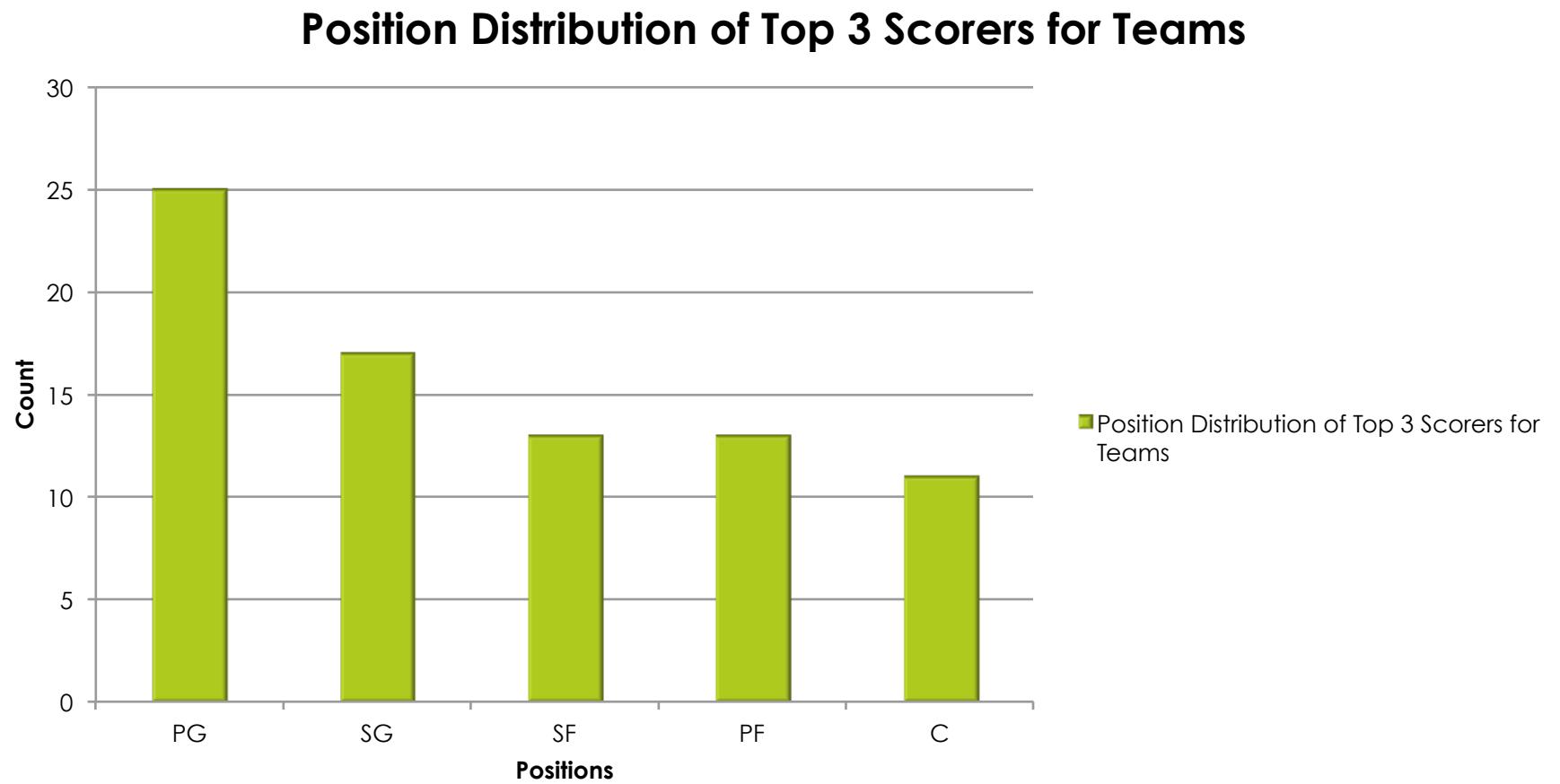
■ Paint Monster

Cluster	0-12 %	12-24 %	>24 %	Count	Key Players
PF-2	0.8750	0.1083	0.0167	30	Tristan Thompson
C-1	0.8707	0.1278	0.0015	23	Hassan Whiteside
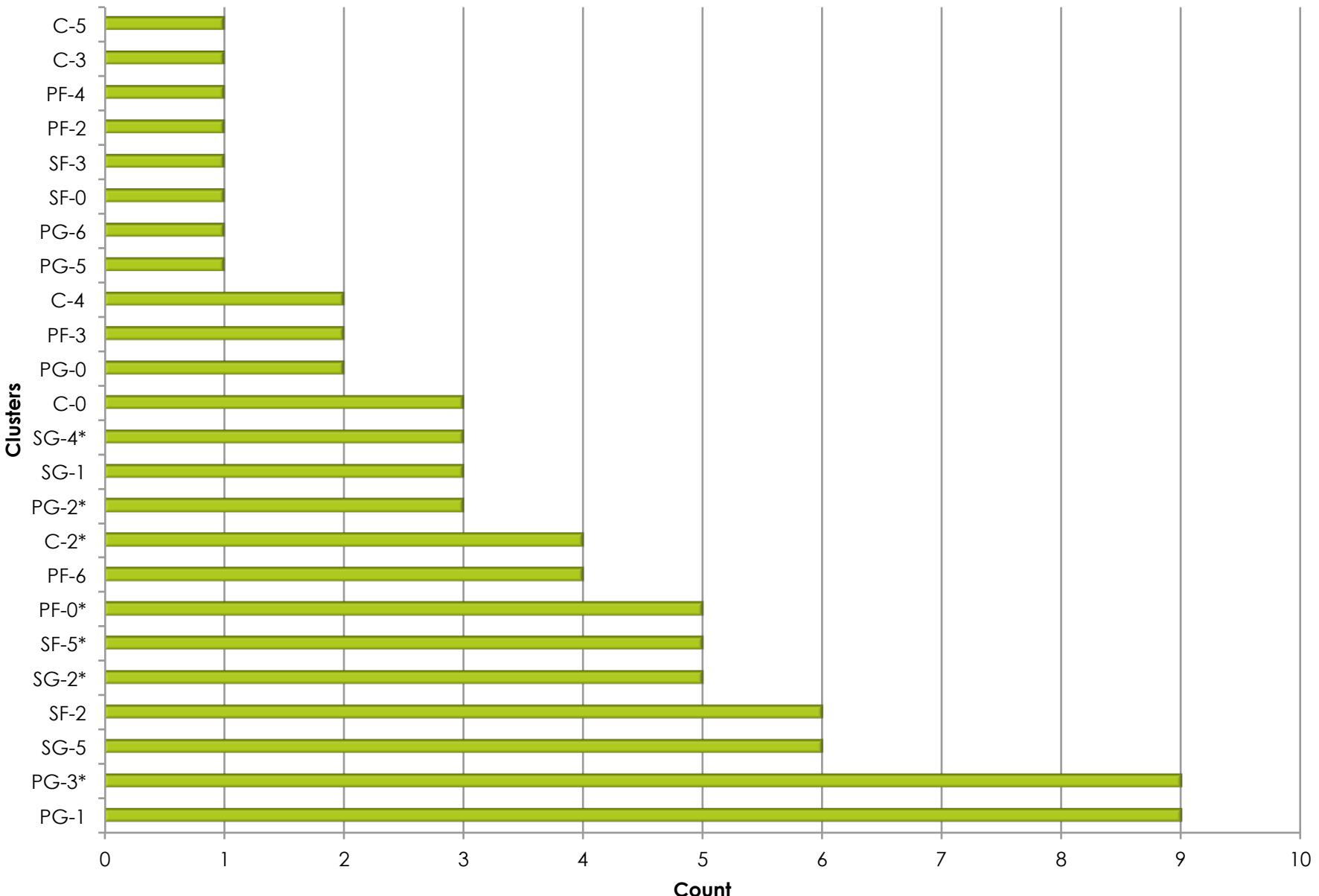
■ Mid-Range and Paint Big Guy--All-Star Caliber

| Cluster	0-12 %	12-24 %	>24 %	Count	Key Players
PF-4	0.4473	0.5196	0.0331	14	Aldridge, Ibaka
C-0	0.5071	0.4728	0.0201	6	Al Horford

Top 3 Scorers of All Teams

Position Distribution of Top 3 Scorers for Teams

Position Distribution of Top 3 Scorers for Teams

Cluster Distribution of Top 3 Scorers for Teams

Top 7 Scoring Clusters

Cluster	Count	Interpretation	Key Players
PG-1	9	Attacking Point Guard	Russell Westbrook
PG-3*	9	Balanced-Through out	Curry, Lillard, Lowry
SG-5	6	Mid-Range, Pull Up/ Shooter	Jamal Crawford, Bradley Beal
SF-2	6	Attacking SF	LeBron James
SG-2*	5	Mid-Range, Play Maker	Wade, DeRozan
SF-5*	5	Player Maker SF	Anthony, Durant, Leonard
PF-0*	5	Skilled Paint Monster	Zach Randolph, Paul Millsap

Future Work

- More Dimensions?

- Combination of Clusters vs Winning?
  - Metrics System that Quantitatively Summarizes Player Cluster Distribution for each Team
  - Regression Model vs Offensive Efficiency/Winning %*

- Welcoming Ideas and Suggestions

Reference

- <u>\<Redefining NBA Positions\></u>
  - <u>Muthu Alagappan</u>
  - <u>https://flowingdata.com/2012/03/21/redefining-nba-basketball-positions/</u>

- \<How to Create NBA Shot Chart in Python\>
  - By Savvas Tjortjoglou
  - <u>http://savvastjortjoglou.com/nba-shot-sharts.html?utm_source=Python+Weekly+Newsletter&utm_campaign=5185ff0538-Python_Weekly_Issue_202_July_30_2015&utm_medium=email&utm_term=0_9e26887fc5-5185ff0538-312727397</u>

- \<Clustering Analysis\>
  - <u>https://en.wikipedia.org/wiki/Cluster_analysis</u>

- <u>Data Source</u>
  - <u>stats.nba.com/stats</u>
  - <u>www.basketball-reference.com</u>

Thank You

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