Is Aaron Gordon's Three Point Shooting for Real: A Simple Model for Projecting Three Point Percentage

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Aaron Gordon's three point shooting in the early 2017-18 NBA season has been surprisingly good. Despite being only a career 28.9% shooter entering the season, he has made 43.8% of his threes as of this writing. At one point about a week ago, he was a remarkable 30/60 on the season. This made me wonder how much of his hot shooting is for real? Has Gordon reached a new level in his game or should we be more skeptical because of the small sample size?

To try and answer this type of question, I decided to try to model three point shooting in a Bayesian manner. Bayesian thinking is a really useful idea in statistics which gives us a framework for adjusting what are called our prior beliefs based on evidence. Coming into the season, we might have a prior belief that Gordon's three point ability is close to what he has shown in his career to date. After watching him shoot 43.8% over 72 attempts, we would reasonably expect his next attempt to go in with a higher probability than we might have expected when the season began. The tricky question is how much exactly to adjust our prior.

My Model

To answer this question, I built a few different models to predict the likelihood of success of three point shots in the 2016-2017 NBA season. The gritty details of my final model are on a page I will soon post, but the idea is pretty simple. Each player begins their career as a projected 34.4% three point shooter. As they begin attempting three pointers, their projected percentage is pulled towards their career three point percentage. The more threes they attempt, the more the pull away from 34.4% and towards their actual percentage. After they reach 665 career attempts, their projected percentage is simply equal to their career percentage.

Why do we push their projection closer to 34.4% (and why the 34.4% and 665 attempts)? For one thing, we need a prediction (i.e. prior) for rookies with no NBA three point attempts. But also, more importantly, a player's three point percentage is particularly noisy in the beginning of their career because they have so few attempts. We pull the projection closer to 34.4% because we need to see more evidence of particularly strong or weak three point shooting before we move too far away from our prior. To answer the question of why 34.4% and 665 attempts are the particular values in the model, those are simply the numbers which perform best on the 2016-17 season data.

The model has one more feature. If a player begins the season with "a lot" of three point attempts (over 750), we scale their career attempts down to 750 at the start of the season. They keep the same career three point percentage. Then as the season goes on we simply take their predicted three point percentage to be equal to their *modified* career percentage (modified because we made their career attempts before the season 750). We do this because we want to give this season's data a higher weight in the prediction. For a player such as LeBron James who began the season with over 4000 career attempts, if we do not make the modification than this season's attempts and makes will simply be drowned out by his long career. Why 750? Once again, this number was chosen to best fit the 2016-17 season data.

Back to Aaron Gordon

This model is nice because it is simple and easy to understand. It's also useful because it gives us a way of quantifying exactly how much we should adjust our preseason expectations based on this year's shooting data. Without a model, it can be hard to sense whether a hot/cold three point shooting start to the season should be taken seriously or not.

Take the example of the hot start of Aaron Gordon. At the beginning of the season, his projected three point percentage (prior) based on his career and the built-in regression towards 34.4% was 30.6%. Now, after going 32 for 73 (43.8%) on the season, the model revises our projection to 31.6%. In other words, the model says to be cautious. He only has 73 attempts this year, so we do not want to lose sight of the fact that he had previously been a poor shooter. This is not to say he has *not* made a meaningful improvement, just that we want to see more evidence.

Another interesting aspect of this model is that it tells us how much evidence we would need to adjust our beliefs to a certain level. Suppose we want to know how many more three pointers Aaron Gordon would have to make at his current season percentage (43.8%) for us to project him as a skilled 36% shooter? The answer according to the model is another 166 attempts.

Of course, this model's simplicity is also a weakness. We should not begin with the belief that all players will be 34.4% shooters as we have college or overseas data which can give us a better prior. Also, other factors such as free throw percentage or percentage of threes taken which are wide open could be useful. This model is just a start. It has a simple structure which gives us an easy, intuitive framework to work with.

Findings

Below are tables of the players who have most positively and negatively changed their preseason projection based on this season's three point shooting. The maximum change in either direction is only about 1.7% because the sample size is small (teams are around 20 games into the season). Note that I only include players with at least 20 attempts on the season and also note that "Career Att" and "Career Pct" are referring to the stats before 2017-18.

Largest Decrease From Preseason Projection

Name	Career Att	Career Pct	17-18 Att.	17-18 Pct.	Preseason Proj.	Proj. Now	Change
Lonzo Ball	0	0.000	87	0.230	0.344	0.329	-1.493
Jrue Holiday	1551	0.366	68	0.221	0.366	0.354	-1.205
Stephen Curry	4379	0.438	149	0.383	0.438	0.429	-0.915
Eric Gordon	2690	0.380	169	0.331	0.380	0.371	-0.900
T.J. Warren	189	0.312	22	0.091	0.335	0.327	-0.837
Damian Lillard	2818	0.370	127	0.315	0.370	0.362	-0.794
Mario Chalmers	1951	0.359	48	0.229	0.359	0.351	-0.783
Khris Middleton	1068	0.404	78	0.321	0.404	0.396	-0.782
J.R. Smith	4657	0.374	95	0.305	0.374	0.366	-0.773
Josh Richardson	342	0.374	81	0.284	0.360	0.352	-0.731
Danilo Gallinari	2023	0.372	50	0.260	0.372	0.365	-0.701
Andrew Harrison	156	0.276	28	0.179	0.328	0.321	-0.697
Dennis Smith	0	0.000	80	0.288	0.344	0.337	-0.680
Joel Embiid	98	0.367	45	0.244	0.347	0.341	-0.674
Jerian Grant	234	0.303	36	0.222	0.330	0.323	-0.659
Lance Stephenson	611	0.304	33	0.212	0.308	0.301	-0.654
Tyler Ulis	79	0.266	24	0.167	0.335	0.328	-0.640
Mike Conley	2391	0.379	77	0.312	0.379	0.373	-0.630
Jamal Murray	344	0.334	79	0.291	0.339	0.333	-0.628
Tim Hardaway	1271	0.352	123	0.309	0.352	0.346	-0.613

Largest Increase From Preseason Projection

Name	Career Att	Career Pct	17-18 Att.	17-18 Pct.	Preseason Proj.	Proj. Now	Change
Robert Covington	1351	0.354	119	0.479	0.354	0.371	1.714
Tobias Harris	877	0.335	104	0.471	0.335	0.352	1.655
Gary Harris	655	0.356	78	0.474	0.356	0.368	1.280
Bojan Bogdanovic	709	0.374	91	0.484	0.374	0.386	1.248
Denzel Valentine	208	0.351	88	0.432	0.346	0.358	1.162
Nemanja Bjelica	302	0.344	39	0.538	0.344	0.356	1.140
Troy Daniels	538	0.420	74	0.446	0.406	0.417	1.134
Victor Oladipo	1108	0.346	94	0.447	0.346	0.357	1.126
C.J. McCollum	1130	0.413	98	0.510	0.413	0.424	1.120
Darius Miller	134	0.351	55	0.473	0.345	0.356	1.065
Aaron Gordon	457	0.289	73	0.438	0.306	0.316	1.036
Will Barton	725	0.327	79	0.430	0.327	0.337	1.017
Malcolm Brogdon	193	0.404	59	0.458	0.361	0.372	1.008
Taurean Waller-Prince	102	0.324	68	0.441	0.341	0.351	0.994
Tyreke Evans	976	0.295	68	0.412	0.295	0.305	0.970
Shabazz Napier	314	0.354	20	0.650	0.348	0.358	0.920
Joe Ingles	691	0.399	90	0.478	0.399	0.408	0.903
Cory Joseph	363	0.317	47	0.468	0.329	0.338	0.877
Jayson Tatum	0	0.000	50	0.460	0.344	0.353	0.872
James Harden	3801	0.364	188	0.404	0.364	0.372	0.815