

Examining Runs Saved Based on Pitch Characteristics

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Many analysts have studied how velocity, location, and movement have an effect on run value in an attempt to assign pitch scores based on these factors. Fangraphs assigns a score to each pitcher's individual pitch and many others have worked on the concept of assigning a run value to each pitch. So when I took on this project I knew I wasn't exactly breaking new ground here. I was curious about the most successful pitchers in 2013 in throwing pitches that most helped their team avoid giving up a run, and breaking it down by both velocity, location, and movement and how that can be used to interpret a pitcher's success. I decided to break this up into a few parts, first examining the effect of velocity.

I started by taking the average remaining runs scored in an inning (abbreviated as ARR going forward for simplicity's sake) based on count and pitch location. There are a few areas where my sample could be tweaked (this is slightly skewed by inherited runners and I only used 2013 regular season data so the sample size is fairly small), but by in large these run expectancies correlated nicely to work done in "The Book" and other places, so I moved forward with it. I then subtracted that value from the ARR based on count, pitch location, and velocity (rounded to the nearest whole number). So if someone threw a 95 MPH 0-0 pitch down the middle and the ARR for a pitch of those three characteristics was .4, I would subtract the ARR of a 0-0 pitch down the middle (say for example that value was .6) from .4, giving a 95MPH 0-0 pitch down the middle a run score of -.2. I did this for all zones (both in and out of the strike zone), counts, and pitch velocities, using an adjusted strike zone that accounted for batter height and handedness. I then took all the pitchers and multiplied the number of pitches thrown in each zone, count, velo by the calculated run value to give him a weighted total and then put it on a 100 pitch scale.

The following are the top and bottom 10 grouped by pitch totals to break out relievers from starters somewhat. Lower is clearly better:

Velocity Runs (Relievers)			
Top 10 (400-1500 pitches)		Bottom 10 (400-1500 pitches)	
Name	Value Per 100p	Name	Value Per 100p
Aroldis Chapman	-6.69	Jeff Francis	2.444
Tanner Scheppers	-4.79	Collin McHugh	2.509
Henry Rodriguez	-4.259	John Lannan	2.786
Jake McGee	-4.065	Pat Neshek	2.804
Bruce Rondon	-3.83	Robbie Erlin	3.011
Trevor Rosenthal	-3.826	Jeremy Horst	3.118
Kelvin Herrera	-3.641	Roy Oswalt	3.24
Craig Kimbrel	-3.563	Andrew Albers	3.623
Jake Diekman	-3.545	Ted Lilly	3.732
Kevin Siegrist	-3.465	Hiram Burgos	4.202

Velocity Runs (Starters)			
Top 10 (min 1500 pitches)		Bottom 10 (min 1500 pitches)	
Name	Value Per 100p	Name	Value Per 100p
Nathan Eovaldi	-2.962	Dallas Keuchel	1.79
Matt Harvey	-2.381	Ryan Vogelsong	1.828
Gerrit Cole	-2.345	Chris Capuano	1.856
Joe Kelly	-2.206	Travis Wood	1.874
Chris Archer	-2.136	Tommy Milone	2.094
Zack Wheeler	-2.057	Scott Diamond	2.151

Top 10 (min 1500 pitches)		Bottom 10 (min 1500 pitches)	
Stephen Strasburg	-1.947	Jason Vargas	2.394
Garrett Richards	-1.806	Josh Collmenter	2.493
Andrew Cashner	-1.719	A.J. Griffin	2.767
Jose Fernandez	-1.663	Barry Zito	3.201

The numbers are not particularly shocking. People who throw harder in certain counts and locations save teams runs. This is a long established fact. The names are not particularly surprising either, especially on the reliever side. Chapman is one of the hardest throwing pitchers in baseball and a particularly successful one at that, so it's not surprising to see him at the top of the list. It is also not surprising to see players like Scheppers, Kimbrel, Harvey, Cole, Strasburg, etc on these lists. A couple of NL East bottom dwellers in the Mets and Marlins are likely excited by this list as they have a couple of players peppering the top 10s. One thing this list does appear to suggest, is that velocity certainly isn't the whole story. Henry Rodriguez really struggled at times this season, as did Garrett Richards. And while Eovaldi had his moments, he certainly wasn't better than Harvey, Strasburg, or even his teammate Fernandez this season. On the flip side, Travis Wood was not one of the worst starters in baseball this season (far from it) and guys like Tommy Milone and Josh Collmenter certainly had value to their teams this year. This doesn't even call into question the fact that guys like Kershaw, Verlander, and Felix Hernandez are noticeably absent from these top 10s.

So that being said, I ran this same exercise, this time controlling for location instead of velocity. The top/bottom 10s are listed below.

Location Runs (Relievers)			
Top 10 (400-1500 pitches)		Bottom 10 (400-1500 pitches)	
Name	Value Per 100p	Name	Value Per 100p
Jesse Crain	-1.52	Rob Wooten	1.582
Edward Mujica	-1.413	Donnie Veal	1.665
Scott Downs	-1.332	Curtis Partch	1.684
Junichi Tazawa	-1.33	Ryan Mattheus	1.73
Greg Holland	-1.307	Allen Webster	1.748
Josh Zeid	-1.116	Roy Oswalt	1.766
Sean Doolittle	-1.065	Ted Lilly	1.857
Dale Thayer	-1.041	Bruce Rondon	1.864
J.J. Hoover	-1.017	Jared Hughes	2.041
Josh Fields	-1.007	Hiram Burgos	2.494

Location Runs (Starters)			
Top 10 (min 1500 pitches)		Bottom 10 (min 1500 pitches)	
Name	Value Per 100p	Name	Value Per 100p
Bronson Arroyo	-1.652	Jeff Locke	0.619
Hisashi Iwakuma	-1.001	Justin Masterson	0.637
Matt Harvey	-0.931	Jarrod Parker	0.645
Wei-Yin Chen	-0.914	Ivan Nova	0.713
Zack Greinke	-0.87	Jacob Turner	0.733
A.J. Burnett	-0.847	Esmil Rogers	0.775
Kyle Lohse	-0.697	Rick Porcello	0.779
Adam Wainwright	-0.68	Lucas Harrell	1.214
Carlos Villanueva	-0.61	Luis Mendoza	1.236
Jonathan Pettibone	-0.571	Barry Zito	1.632

The fact that Matt Harvey scores well on both lists should be very exciting for the New York Mets. Second, it's interesting to note that the influence location has on the run values seems to be much smaller than velocity (this would certainly be an area for further study in terms of determining exactly how much more velocity counts than location). Third, some of the names on this list are quite interesting. The fact that Arroyo was number one helps explain how he is still in the league throwing at his velocity (let's just say he finished closer to the bottom on the velocity version than he did to the top). It also helps explain how Bruce Rondon (who finished near the top on the velocity version) didn't have quite the success of his reliever counterparts on the velocity list.

However, we're still missing some of the biggest names in baseball on these lists so let's take a look at some of those individual cases below.

Velocity and Location Runs for Five Top Starters

Name	Velocity Value Per 100p	Location Value Per 100p
Justin Verlander	-0.848	0.146
Clayton Kershaw	-0.802	-0.307
David Price	-0.798	-0.387
Felix Hernandez	0.247	0.022
Yu Darvish	-0.422	0.066

First things first: Verlander, Kershaw, Price, and Darvish all finished above average on the velocity side of things, and Price and Kershaw both finished on the plus side of things for location as well, they just didn't finish in the top 10s of their respective categories. It would be interesting to see how Price fared pre-DL and post-DL this season; I suspect the difference would be notable. Amazingly, Felix Hernandez finished on the wrong side of both categories. I think there are a number of ways to look at this. One way, and probably the incorrect way, is to say that Felix Hernandez isn't quite as good as we all think he is. It's hard to argue with his success over the past season as he was again one of the better pitchers in baseball, with an fWAR of 6.0. I think it's far more likely to say that there are other variables that I didn't consider in the first parts of this exercise that contributed tremendously to his success this season.

Two of those variables are horizontal and vertical movement. See below for the top and bottom 10s when accounted for in a similar sense:

Horizontal Movement Runs (Relievers)			
Top 10 (400-1500 pitches)		Bottom 10 (400-1500 pitches)	
Name	Value Per 100p	Name	Value Per 100p
Danny Duffy	-3.543	Donnie Veal	2.021
Paco Rodriguez	-2.407	Alex Sanabia	2.1
Sergio Romo	-2.372	Brett Anderson	2.114
Josh Edgin	-2.042	Brett Oberholtzer	2.278
Joe Smith	-2.01	Tyler Lyons	2.36
Darren O'Day	-2.005	Mitchell Boggs	2.508
Jason Grilli	-1.929	Johnny Hellweg	2.629
Vinnie Pestano	-1.763	Philip Humber	3.417
Sonny Gray	-1.75	Rich Hill	4.709
Jamey Wright	-1.675	Greg Burke	6.019

Horizontal Movement Runs (Starters)			
Top 10 (min 1500 pitches)		Bottom 10 (min 1500 pitches)	
Name	Value Per 100p	Name	Value Per 100p
Yu Darvish	-2.621	Randall Delgado	0.833
Clayton Kershaw	-1.615	Wily Peralta	0.865
Justin Masterson	-1.417	Ryan Vogelsong	0.942
Bronson Arroyo	-1.352	Joe Saunders	0.96
Jose Quintana	-1.172	David Price	1.061
Hyun-Jin Ryu	-1.031	J.A. Happ	1.08
Alex Cobb	-1.018	Jeff Samardzija	1.259
Mike Minor	-1.016	Jake Westbrook	1.282
Jose Fernandez	-1.01	Erik Bedard	1.362
Adam Wainwright	-0.975	Dallas Keuchel	1.435

Finally we see guys like Darvish and Kershaw showing up towards the top of the list. Not surprisingly, I don't think, we see a lot of guys who are known for big sweeping sliders towards the top of the lists. There is a very inherent bias in the horizontal movement data, however, and that is that the numbers can be greatly skewed based on where a pitcher is releasing the ball and to which side of the plate he's throwing. For example, a RHP who throws a lot of sliders from the very far 3rd base side of the rubber to the outside corner for a RHB will score better on this than a RHP who throws the equivalent number of sliders to the outside corner from the far 1st base side. I think you see that issue with guys like Price and Samardzija, both of whom made adjustments over the past year to where on the rubber they were throwing from (along with changes to their sliders to more of cutters) and this list is probably not entirely reflective of the quality of their slider/cutter. Also, it should be noted that I did additionally control for pitcher handedness with horizontal movement.

With that being said here is the vertical movement top and bottom 10s. There is some bias here to give advantages to tall pitches that throw down in the zone, but it's not nearly as pronounced as the horizontal movement bias (as you can see given that Tim Collins is number two amongst relievers).

Vertical Movement Runs (Relievers)			
Top 10 (400-1500 pitches)		Bottom 10 (400-1500 pitches)	
Name	Value Per 100p	Name	Value Per 100p

Top 10 (400-1500 pitches)		Bottom 10 (400-1500 pitches)	
Sean Doolittle	-4.097	Allen Webster	1.521
Tim Collins	-3.838	Jonathan Broxton	1.523
Nick Hagadone	-3.433	Mike Adams	1.558
Jesse Crain	-3.156	Pedro Hernandez	1.599
Antonio Bastardo	-2.861	Mitchell Boggs	1.618
Michael Kohn	-2.787	Rich Hill	1.87
Andrew Bailey	-2.771	Greg Reynolds	2.23
Drew Smyly	-2.742	Brett Anderson	2.276
Arodis Chapman	-2.687	Johnny Hellweg	2.517
Greg Holland	-2.667	Philip Humber	2.926

Vertical Movement Runs (Starters)

Top 10 (min 1500 pitches)		Bottom 10 (min 1500 pitches)	
Name	Value Per 100p	Name	Value Per 100p
Clayton Kershaw	-4.102	Chris Capuano	1.067
Josh Collmenter	-3.86	Mark Buehrle	1.113
Chris Tillman	-2.804	Ivan Nova	1.126
Marco Estrada	-1.694	Tim Hudson	1.13
Matt Moore	-1.597	Matt Cain	1.199
Justin Verlander	-1.301	Joe Saunders	1.206
Jered Weaver	-1.251	Ryan Vogelsong	1.257
Mat Latos	-1.19	Mike Pelfrey	1.293
Tommy Milone	-1.183	Lucas Harrell	1.441
Yu Darvish	-1.148	Brandon McCarthy	1.451

Again we see Kershaw & Darvish in the top 10, joined this time by Verlander and a number of other players known for sharp downward breaking balls. This helps support the previous theory that their successes were based on other factors besides just velocity and location. We can also see that Kershaw and Collmenter really blew away the field in these categories when it comes to starters, which both being nearly a run better per 100p than their 3rd place competitor. I think it's fair to say that Darvish and Kershaw have probably the best breaking stuff in the league based off their horizontal and vertical movement scores. In case you are wondering, Felix Hernandez finished better than average in both the horizontal and vertical movement categories, just not in the top 10s, helping to explain some of his success is certainly related to the amount of movement he gets on pitches. It is certainly interesting though that the pitcher with the 6th best fWAR in baseball didn't finish in the top 10s in any of these categories. Similar to Felix Hernandez, guys like Anibal Sanchez and Max Scherzer did pretty well in the categories you'd expect them to. Sanchez did well in the velo, location, and vertical categories, while Scherzer did particularly well in the velo (just missing the top 10) category as well as finishing above average in the location category. Their absence from the top 10s was not nearly as surprising as Hernandez and they did pretty well overall.

All in all, this exercise serves a few purposes. One, it clearly shows that velocity carries more weight than location in terms of preventing runs. This is not to say that location doesn't carry weight (as it clearly does), however this shows us that velocity does carry significantly more. Of course, this is not a new or surprising development, but it does provide a method of quantifying its effect. It also seems to support the idea and pitches with downward movement have more value than pitches with horizontal movement which in and of itself is also probably not a surprising discovery. Overall, this serves as a nice test to look at where a pitcher is having success (or not having success). We can clearly see that some guys are getting by purely on velocity (e.g. Rondon), while others succeed on location (e.g. Arroyo), while others are combining both (e.g. Harvey). It also helps to locate guys who are perhaps benefiting from other reasons, like Hernandez, who benefits from the amount of movement he gets on his pitchers more so than he does on pure velocity and location. Perhaps most interestingly, it also pinpoints guys who may be able to make adjustments and get more out of their "raw talent" level. While I didn't get into much detail on players outside of the top 10s, there are a number of guys who score pretty well on some combination of these lists but struggled mightily this season. One guy who famously struggled this season, Phil Hughes, actually finished better than average on every single list. Much has been written on his struggles and propensity to give up the long ball this season, but he could be one guy who, based on this study, may be able to re-discover success next season with a few slight tweaks. Areas for future improvement include controlling for pitch type, using a larger sample size to create more reliable run values, comparing how these values correlate season to season, and working to find a hitter applicable version.

Finally, I'll leave you with a table of six free agent pitchers and their respective score per 100 pitches.

Run Values for Notable Free Agent Starters

PITCHER	Vertical	Horizontal	Velo	Location	Sum
A.J. Burnett	0.855	-0.523	-1.269	-0.847	-1.784
Ervin Santana	0.129	-0.184	-0.529	-0.145	-0.729
Matt Garza	-0.792	0.101	-0.931	-0.21	-1.833
Phil Hughes	-0.682	-0.248	-0.507	-0.32	-1.756
Ubaldo Jimenez	0.293	-0.079	0.184	-0.007	0.392
Ricky Nolasco	0.325	0.423	0.744	-0.381	1.111

As stated before, this system really works well for Phil Hughes. It ranks him similarly to other top pitchers on the market like A.J. Burnett and Matt Garza. Ervin Santana also scores well, though not quite as well as the first three. Interestingly, this system is pretty down on both Ubaldo Jimenez and Ricky Nolasco. Without knowing how these values correlate year to year, it is difficult to predict how we should interpret these numbers going forward, however, it would give me enough pause when it comes to giving out lavish contracts to pitchers like Jimenez and Nolasco and I would encourage teams to research further on these particular players if they were considering signing them to long term contracts.