Pitching Metrics Introduction

by Harry Pavlidis, Jeff Long, and Kate Morrison

While there is no shortage of metrics that purport to describe how “good” or “bad” a pitcher really is, there has been less focus on metrics that describe how a pitcher gets to his results. This, then, is the goal of the metrics introduced here: to provide as comprehensive a picture of a pitcher as possible, to be used as quantitative illustrations with his results. We are happy to introduce three new “top-line” pitching metrics. Our pitcher pages in this book will also include some other important aspects of “describing” a pitcher. Let’s find out what these are, new and old.

Power Score

Chris Sale

POWER

51

56th of 150

Kenley Jansen

POWER

73

5th of 150

What is a “power pitcher”? We hear the term a lot, usually in reference to someone like Justin Verlander, but it’s never been an exact term, for all that it seems to apply to the same general set of characteristics. As part of developing a new suite of pitching metrics and diving deeper into the ways we break down the art of throwing a ball very hard, we’re taking a look at “power pitching” and quantifying exactly what it means to be a “power pitcher.”

Luckily for us, the pieces to measure whether or not someone is quantifiably a “power pitcher” already exist, it’s just deciding how best to put them together. Clearly, velocity is a large part of the equation, as the “power” part of the description, and we weight peak fastball velocity the heaviest when constructing these rankings.

Power pitchers use their fastballs a lot, as well, as it tends to be their highest-graded pitch and the one they feel most comfortable leaning on in stress situations. Other determining factors include median off-speed velocity—power pitchers tend to rely on harder off-speed pitches, so sliders over curveballs. The classic example here is Verlander, with his hard, biting power slider. This also points to the fact that the power pitcher isn’t utterly relying on pitch velocity differential, but on something closer to pure velocity. Differential and deception are obviously useful components, but for the power pitcher, they’re of less concern.

As of right now, our Power Score is composed of these three identifiable parts: fastball velocity (three parts), fastball percentage (two parts), and the velocity of all off-speed pitches (one part). There are some other factors that we considered when developing this metric, such as the tendency to work up in the zone and to lean on fastballs in putaway counts, but the current version of this metric only includes the three main components discussed above. From there, we can elaborate: a pitcher who relies on his high-velocity fastball in a two-strike count, to “throw the ball past the batter.” How, though, do we take those words and turn them into actionable numbers? How do we accurately define what is seemingly nebulous? We’ll work on that for future versions.

Stamina Score

Chris Sale

STAMINA

85

3rd of 150

Kenley Jansen

STAMINA

48

140th of 150

As with all of these metrics, our measure of stamina, alone, has nothing to do with how “good” or “bad” a pitcher is; it is simply an objective measurement of how much of a workload any pitcher is capable of carrying. Since workload exists beyond Major League Baseball, we also included any of a pitcher’s regular-season minor-league efforts in calculating Stamina.

To calculate Stamina Score, we looked at different ways of valuing days of rest, numbers of pitches, and batters faced per game. What we found most effective is a model that combines calculating the daily number of pitches thrown from a six-day moving average, with the straight average of batters faced per game against the square root of the mean of the days of rest between games. Not every pitcher at the top of these rankings is good, as sometimes teams carry a pitcher who can throw a large number of pitches but is only really good for games that are either already out of hand or in desperate numbers of innings. However, through selection,
pitches who see worse results tend to see fewer innings at a time, and more days between innings, for relievers. Bad starters also tend to see fewer pitches per outing over time, influencing their positioning on these rankings. This simplistic score is sufficient for the first generation of this metric. Future editions might benefit from in-game measurements (sustaining fastball velocity deep into outings, or back-to-back games).

**Command Score**

**Command - Chris Sale**  
**Command - Kenley Jansen**

One of the most challenging aspects of pitching to quantify, command indicates that a pitcher can throw the ball where he intends to. Our Command Score builds on Called Strikes Above Average (CSAA), which is the pitcher’s component of our framing model. To build on that we’ve identified target points in each corner of the zone using the likelihood of a pitch to be called a strike and quantified the pitcher’s ability to hit that spot consistently. Pitchers are penalized for missing spots by a significant amount—either getting too much of the plate or missing off of it—to highlight their ability to effectively work the edges of the zone.

Command Score provides a new heuristic for understanding the ability of a pitcher to command his pitches. Command Score is a composite statistic that includes CSAA in addition to other factors that we believe reflect a pitcher’s ability to command his pitches.

We’ve also broken down the strike zone into quadrants that highlight a pitcher’s ability to miss the most dangerous part of the zone. These quadrants are mapped against called strike probability\(^1\) (CSProb) contours to identify the ideal target in each section of the zone.

Using CSProb we can identify an appropriate target area in each quadrant and assess a pitcher’s ability to hit that target with a pitch. Every pitch is mapped to the nearest quadrant, and the pitcher is penalized based on how much he misses that target. Pitches that miss the target toward the middle of the zone are penalized at a lower rate than those that miss outside the zone because, generally speaking, strikes are better than balls. Of course, we’d be remiss if we didn’t acknowledge that pitches catching too much of the zone can be and often are hit for home runs, but pitchers with better command typically throw more strikes than those without.

Once all pitches are aggregated, each pitcher is compared to his peers to identify their relative ability to command their pitches. We recognize there are myriad additional elements to command, but we’ve found this version to provide a meaningful guide into the command skill, and perhaps style, of pitchers.

**Pitch Types**

In addition to our new metrics, our pitcher profiles also include a table with pitch type, velocity, and movement information. Pitch Type and Usage % are familiar, but we’ve beefed up the raw information with Index numbers—that is, we’ve given each pitcher’s velocity, horizontal movement, and vertical movement context within the league. Each index is normalized to 100, and the higher or lower a number is, the more or less velocity or movement than the average it displays. As for HMov (Horizontal Movement) and VMov (Vertical Movement), these numbers are the average, in inches, that the pitch moves as it comes in toward the plate, as caused by the spin put on the ball when the pitch is released. We measure a pitch over the long flight of the ball, that is, an additional ten feet of flight time than sources such as MLBAM, FanGraphs, and MLB’s GameDay interface. This, along with our inclusion of gravity into the VMov calculation, allows us to have a much more realistic representation of what a pitch actually does, as opposed to how it performs in a hypothetical environment.

- **FA** Fastball; primarily four-seam  
- **SI** Two-seam fastballs and/or sinkers  
- **FC** Cutters, sometimes further split into “hard” (more like a cut fastball) or “soft” (more like a hard slider)  
- **CH** Change-ups, splitters mostly excluded  
- **FS** Split-fingered-pitches, forkballs, and some split-changes  
- **SL** Sliders and slurve  
- **CU** Curveballs, including spike- and knuckle-curves; some slurvy curves, too  
- **CS** Slow curves, or eephus pitches

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1. Called strike probability indicates the likelihood that a particular pitch will be called a strike. CSProb controls for a number of factors including batter handedness, count, pitcher, and more.
Chris Sale Pitch Types

<table>
<thead>
<tr>
<th>Type</th>
<th>Freq</th>
<th>Velo</th>
<th>H Mov</th>
<th>V Mov</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH</td>
<td>16.6%</td>
<td>86.9 [107]</td>
<td>17.2 [67]</td>
<td>-28.3 [97]</td>
</tr>
<tr>
<td>FA</td>
<td>37.4%</td>
<td>95 [108]</td>
<td>13.9 [68]</td>
<td>-16.2 [97]</td>
</tr>
<tr>
<td>SI</td>
<td>13.1%</td>
<td>93.1 [104]</td>
<td>17.5 [64]</td>
<td>-23.7 [86]</td>
</tr>
<tr>
<td>SL</td>
<td>32.9%</td>
<td>80 [81]</td>
<td>-10 [124]</td>
<td>-41.7 [74]</td>
</tr>
</tbody>
</table>

DRA

While Earned Run Average (ERA) as it exists tells us what runs were assigned to a pitcher following a certain set of rules, averaged over 9 innings, Deserved Run Average (DRA) is our way of calculating what runs a pitcher most likely deserved to give up, independent of defense, but allowing for a pitcher's own defense and effect on batted-ball outcomes. First introduced in 2015, DRA has been refined each off-season and is a valuable resource for understanding the most likely contributions of a pitcher. Like defense-independent metric FIP, DRA is on a runs allowed per 9 innings scale, although unlike FIP, it is scaled to match RA9 rather than ERA. DRA attempts to control for, among other things, stadium effects, catcher framing, pitch classifications, game temperature, and other components, creating a well-rounded portrait of how a pitcher most likely performed.

2017 Top Starters (min. 162 IP)

<table>
<thead>
<tr>
<th>Name</th>
<th>IP</th>
<th>DRA</th>
<th>ERA</th>
<th>FIP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corey Kluber</td>
<td>203.2</td>
<td>2.05</td>
<td>2.25</td>
<td>2.47</td>
</tr>
<tr>
<td>Max Scherzer</td>
<td>200.2</td>
<td>2.26</td>
<td>2.51</td>
<td>2.91</td>
</tr>
<tr>
<td>Chris Sale</td>
<td>214.1</td>
<td>2.37</td>
<td>2.90</td>
<td>2.43</td>
</tr>
</tbody>
</table>

2017 Top Relievers (min. 50 IP)

<table>
<thead>
<tr>
<th>Name</th>
<th>IP</th>
<th>DRA</th>
<th>ERA</th>
<th>FIP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Craig Kimbrel</td>
<td>69</td>
<td>1.89</td>
<td>1.43</td>
<td>1.39</td>
</tr>
<tr>
<td>Darren O’Day</td>
<td>60.1</td>
<td>1.94</td>
<td>3.43</td>
<td>3.68</td>
</tr>
<tr>
<td>Roberto Osuna</td>
<td>64</td>
<td>2.19</td>
<td>3.38</td>
<td>1.71</td>
</tr>
</tbody>
</table>

Release Points

Pitchers throw from all over the place—moving sides of the rubber sometimes, or dropping down from time-to-time (or all the time). Instead of providing a seemingly abstract pair of coordinates representing release point, we’ve decided to plot the average arm angle for each pitcher in the combined plots (see below).

In the diagram, the line from which the pitches originate represents the pitcher’s average arm path, estimated by the Lentzner Axis. This will show how the pitcher is delivering pitches, not just where. Submariners and side-armers will look funny, which is probably accurate. Guys with multiple arm angles just get one Lentzner Axis; we’ll try to make that better in the future. Generally, we think these will help you picture a pitcher, even with that limitation.

Tunneling

The concept of pitch tunnels—that a pitcher can be more effective by making his pitches more difficult to distinguish from one another—isn’t a new one, though being able to quantify it certainly is. Not only have we included the traditional pitch tunnels data that was introduced in January 2017, but we’ve also included a new way to look at and think about pitch tunnels.

The pitch tunnels table includes the same tunnel metrics that were introduced in early 2017 and also includes an indexed version of each individual statistic for each pitcher. These indices (centered on 100) tell you quickly how much smaller or larger a pitcher’s tunnels (or speed mixing) are than those of the average major-league pitcher. These indices are a different way to look at pitch tunnels, especially considering the fact that tunneling is but one of the many ways a pitcher can be successful (along with having really good stuff, throwing the ball by people, having excellent command, etc.).

The metrics included in the tables for each pitcher are:

- Release Differential: When analyzing pitchers, we often talk about consistency in their release point, pointing to scatter plots to see whether things look effectively bunched or not. This stat measures the average variation between back-to-back pitches at release.
- Tunnel Differential: This statistic tells you how far apart two pitches are at the Tunnel Point—the point during their flight when the hitter must make a decision about whether to swing or not (roughly 175 milliseconds before contact).
- Plate Differential: This statistic shows how far apart back-to-back pitches end up at the home plate, roughly where the batter would contact the ball. This includes differentiation generated by pitch break and trajectory of the ball (which includes factors like gravity, arm angle at release, etc.).
- Speed Changes: This is the average difference, in seconds of flight time, between back-to-back pitches.

In addition to these tables, we’ve also included some new visualizations of the tunneling phenomenon to better showcase how it works for different pitchers. In the introduction to the new data we said, “The first step in quantifying tunnels is to forget everything we think we know about pitchers. The first step is to think like a hitter.” Unfortunately, we largely ignored this advice when it came

to the actual quantification and visualization of tunneling. As with most everything else done with pitching, we looked at things from the catcher’s point of view.

Catching aren’t the ones trying to hit the ball, however. To truly understand the impact of pitch tunnels, it was critical that we look at things from a hitter’s viewpoint, and that includes mimicking the viewpoint of both a left-handed and a right-handed hitter. This isn’t a novel concept either, as World Series champion and BP alum Mike Fast did so nearly a decade ago. ³

This new perspective provides a completely new way of looking at and understanding the concept of pitch tunnels—not to mention helping to crystallize the why behind platoon splits among hitters.

Each chart includes the release of the ball, the flight path, and the average destination at the plate, identified by the pitch type indicator. The pitch type indicators are repeated roughly 0.25 seconds after release, and of course at the plate. In between, gray dots show the flight path of the ball, with each dot indicating a 0.01 second interval. The visuals include the mound (the black bar) and home plate for visual reference. To take things a step further, we’ve also included zone contour maps, indicating the range of locations that each pitcher typically works in. These are often different for right-handed and left-handed hitters, as pitchers mix up their targets and pitch mix to get opposing hitters out. As a result, these contours highlight the areas that a hitter on each side of the plate will see pitches against a particular pitcher. Each chart includes a small legend indicating which pitch is represented by each icon.

Carlos Carrasco Tunnel vs RHH