

The Rich Hill Index: Optimizing a MLB Pitcher's Repertoire

By Alex Corb, Jeremy Swack, and Henry Gutkin

Introduction

Rich Hill and his transformation



2007 ERA: 3.92

2007 Curveball Usage: 27.3%

(2007 is the only year between 2004 and 2014 in which he was a qualified pitcher)

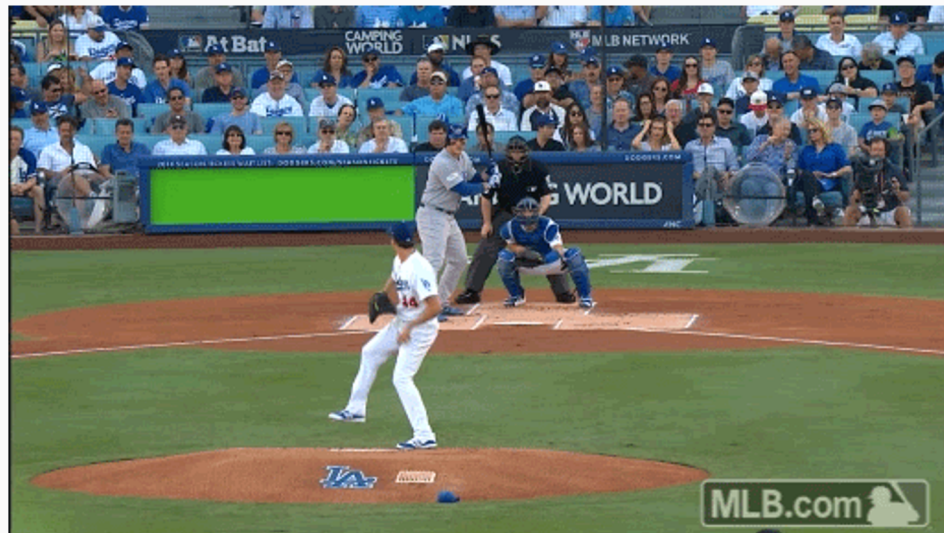
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2015 - 2019 ERA: 2.93

2015 - 2019 Curveball Usage: 39.1%

Rich Hill... and his pretty decent curveball

Oh. This is Anthony Rizzo, a 3x All-Star getting FOOLED by a Rich Hill curveball.



Rich Hill's Transformation Continued...

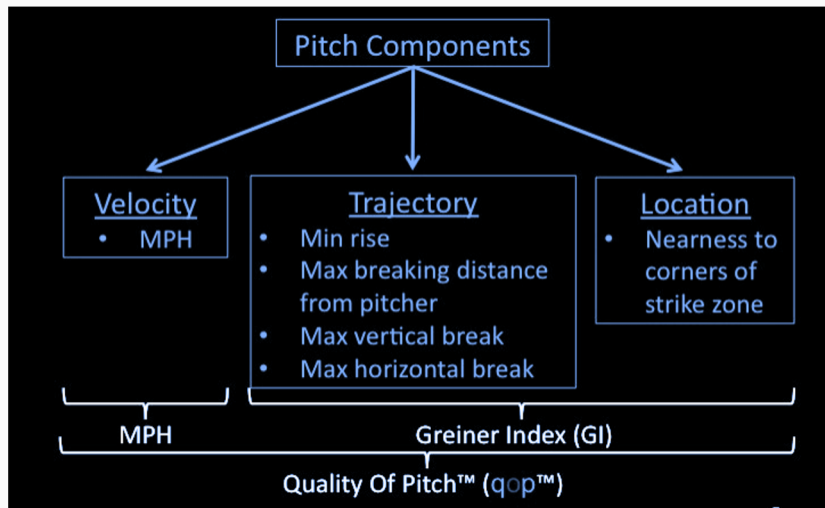
Rich Hill's career
curveball **Quality Of
Pitch Average
(QOPA): 5.59**



The Rick Hill Example: an increase of usage of Rich Hill's one of a kind curveball led to his eventual success in the MLB.

Quality of Pitch (QOP) background

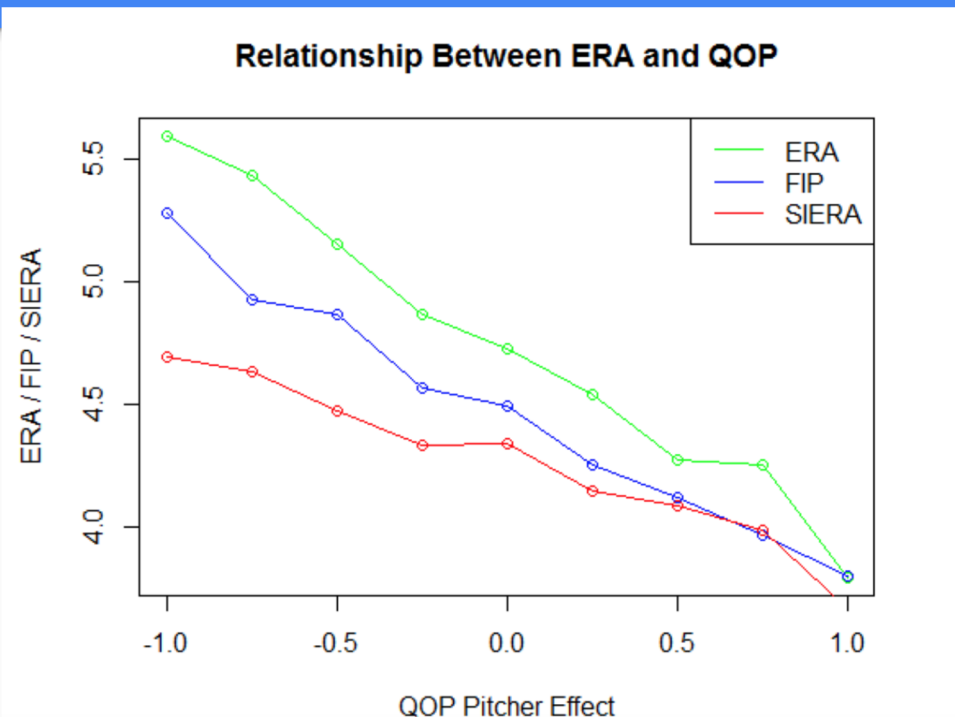
QOP is a pitching metric developed by Jason Wilson that takes into account velocity, pitch break, location, lateness of break, while excluding the outcome.



- QOPA is rated on difficult to read scale, so we standardized it by pitch (Z_QOPA)



QOP's Predictiveness of Pitcher Performance



- **CONCLUSION:** A pitcher with high QOP values for their pitches has on average, a lower ERA

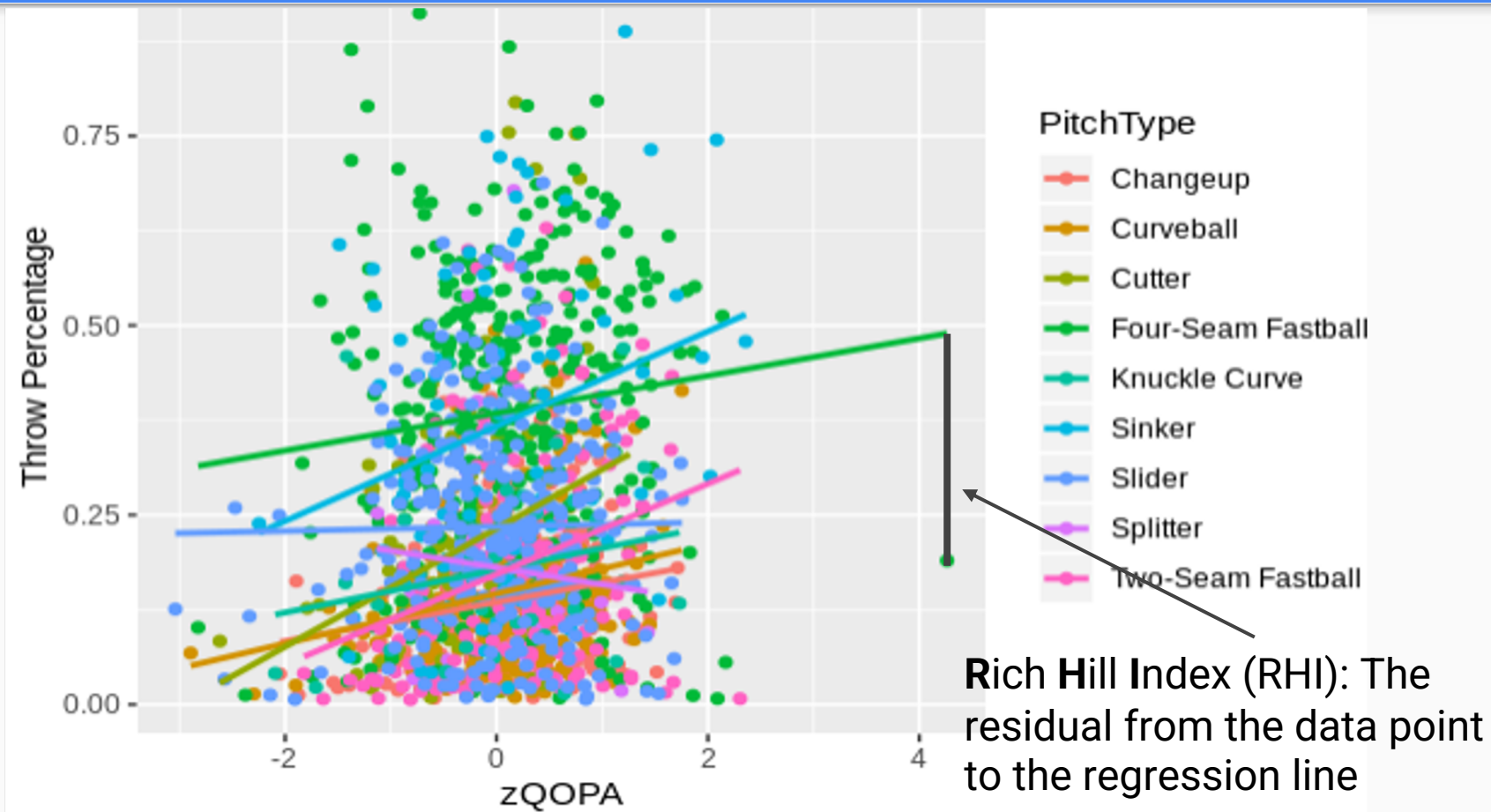
Filtering Data

Filtering:

- Minimum of 450 pitches thrown in 2019
- Usage of pitch must thrown at least 10 times in order to avoid misidentification or a pitcher's lack of comfort in that pitch

| | Name | NP | PitchType | Z_QOP | T_pct | if_else(NP > 800, "Starter", "Reliever") | pred | resid |
|----|---------------|------|--------------------|--------------|-------------|--|------------|--------------|
| 1 | Aaron Brooks | 880 | Two-Seam Fastball | 1.090847952 | 0.362500000 | Starter | 0.23688795 | 0.125612051 |
| 2 | Aaron Brooks | 880 | Changeup | 0.967025264 | 0.150000000 | Starter | 0.15986509 | -0.009865086 |
| 3 | Aaron Brooks | 880 | Four-Seam Fastball | 0.319326337 | 0.217045455 | Starter | 0.39212410 | -0.175078646 |
| 4 | Aaron Brooks | 880 | Slider | 0.120407749 | 0.229545455 | Starter | 0.23499584 | -0.005450388 |
| 5 | Aaron Brooks | 880 | Curveball | -0.276871542 | 0.027272727 | Starter | 0.13710643 | -0.109833698 |
| 6 | Aaron Bummer | 511 | Sinker | 0.654973410 | 0.665362035 | Reliever | 0.40806121 | 0.257300824 |
| 7 | Aaron Bummer | 511 | Slider | -0.690853266 | 0.082191781 | Reliever | 0.23265602 | -0.150464238 |
| 8 | Aaron Bummer | 511 | Four-Seam Fastball | -0.743651263 | 0.107632094 | Reliever | 0.36590115 | -0.258269058 |
| 9 | Aaron Bummer | 511 | Cutter | -0.812370921 | 0.136986301 | Reliever | 0.16888207 | -0.031905772 |
| 10 | Aaron Nola | 1957 | Curveball | 1.450210167 | 0.105263158 | Starter | 0.19381571 | -0.088552552 |
| 11 | Aaron Nola | 1957 | Knuckle Curve | 0.947153192 | 0.244251405 | Starter | 0.20472397 | 0.039527440 |
| 12 | Aaron Nola | 1957 | Changeup | -0.038571884 | 0.180378130 | Starter | 0.13400955 | 0.046368575 |
| 13 | Aaron Nola | 1957 | Two-Seam Fastball | -0.559426721 | 0.119059785 | Starter | 0.13848911 | -0.019429321 |
| 14 | Aaron Nola | 1957 | Four-Seam Fastball | -0.589596538 | 0.348492591 | Starter | 0.36970158 | -0.021208988 |
| 15 | Aaron Sanchez | 1712 | Changeup | 0.573079989 | 0.179906542 | Starter | 0.14973611 | 0.030170427 |
| 16 | Aaron Sanchez | 1712 | Curveball | 0.288355200 | 0.221378505 | Starter | 0.15566583 | 0.065712677 |
| 17 | Aaron Sanchez | 1712 | Four-Seam Fastball | 0.026622360 | 0.285046729 | Starter | 0.38490329 | -0.099856559 |
| 18 | Aaron Sanchez | 1712 | Two-Seam Fastball | -0.049783072 | 0.311331776 | Starter | 0.16887698 | 0.142454792 |
| 19 | Adam Cimber | 495 | Four-Seam Fastball | 4.263127289 | 0.189898990 | Reliever | 0.48941504 | -0.299516050 |
| 20 | Adam Cimber | 495 | Sinker | 2.356729253 | 0.478787879 | Reliever | 0.51452848 | -0.035740603 |
| 21 | Adam Cimber | 495 | Slider | 0.919376930 | 0.296969697 | Reliever | 0.23730021 | 0.059669482 |
| 22 | Adam Conley | 630 | Changeup | 0.666382817 | 0.196825397 | Reliever | 0.15213508 | 0.044690315 |
| 23 | Adam Conley | 630 | Four-Seam Fastball | 0.535002952 | 0.622222222 | Reliever | 0.39744470 | 0.224777524 |
| 24 | Adam Conley | 630 | Slider | -0.715436934 | 0.158730159 | Reliever | 0.23258511 | -0.073854956 |

Pitcher Optimization: Multiple Regression Model



Potential Improvements

- A more accurate model would be logistic with horizontal asymptote close to 80% mark
 - Solution: Create model based off best pitchers, and fit the rest of the data to that
- RHI values do not add up to 0
 - Although the values are not exact, the model is still very effective at giving recommendations

Benefits of the Model

- Adheres to conventional wisdom, good for implementation in MLB
- Makes especially accurate suggestions for pitches in upper left and lower right quadrants

Adam Cimber

| Pitch | Z_QOP | Current Throw % | RHI |
|--------------------|-------|-----------------|--------|
| Sinker | 2.4 | 47.9% | -3.6% |
| Slider | 0.9 | 29.7% | 6.0% |
| Four-Seam Fastball | 4.3 | 19.0% | -30.0% |

*All values rounded to tenths place

Yup. That's a good pitch



Sam Dyson

| Pitch | Z_QOP | Current Throw % | RHI |
|--------------------|-------|-----------------|--------|
| Slider | 1.7 | 6.1% | -17.9% |
| Sinker | 0 | 46.2% | 9.4% |
| Changeup | 0 | 11.8% | -1.7% |
| Cutter | -0.4 | 23.7% | 3.8% |
| Four-Seam Fastball | -0.5 | 11.97% | -2.5% |



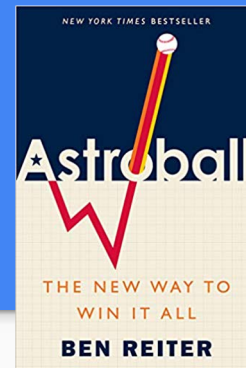
Blake Snell

| Pitch | Z_QOP | Current Throw % | RHI |
|--------------------|-------|-----------------|--------|
| Curveball | -0.6 | 26.5% | 13.6% |
| Changeup | 1.4 | 20.9% | 3.9% |
| Four-Seam Fastball | 1.4 | 45.0% | 3.12% |
| Slider | 0.2 | 7.1% | -16.5% |

A Vanishing Act, by Blake Snell



RHI's Relation to Baseball Trends



- More efficient to have a rotation of relievers that specialize in 2-3 high QOP pitches to open games than starters that have an arsenal of 5 or so weaker QOP pitches
- Although the data is not publically available, the Houston Astros have seemingly been optimizing their pitcher's repertoires in a similar way

Tampa Bay Rays manager Kevin Cash, has introduced a high usage of openers



Questions?