

## Pitch Characteristics Effect on Home Runs

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Home run rates have been a popular discussion in baseball lately due to home run totals rising at a record breaking pace in recent years. Although we have seen similar trends throughout the history of baseball, current rates of home runs are at an all-time high. Determining the cause of this increase in home runs will help shape the future of the game.

I retrieved pitch data from 2015-2017 from Baseball Savant to be used for analysis. The initial investigation was set out to determine which pitch type was hit for a home run the highest percentage of the time. I completed this by using pitch data to determine the relationship between the characteristics of each pitch thrown and home runs. I divided pitches into three pitch types, fastball, breaking ball, and off speed. I then created a hit quality model by using a logistic regression model with transformed launch speed and launch angle variables to determine the quality of contact for each batted ball. Further, I created a pitch quality model using linear regression of release speed, location, spin rate and transformed movement. Finally, I examined trends in the data to determine the cause of the change. I used launch speed and launch angle as it relates to home run probability, changes in the relationship between pitch characteristics and quality of contact, and the change in pitch characteristics to determine pitch quality from 2015-2017.

The pitch quality model was used to determine the likelihood of a home run being hit from each pitch, this likelihood was classified as "pitch quality". When analyzing results of the pitch quality model on the data, I found that pitches thrown in 2017 had a higher likelihood of being hit for a home run than in 2016. Along with pitch quality numbers being higher overall, hit quality comparisons from home run probability on fly balls showed up to an 8% higher likelihood of a fly ball being hit for a home run in 2017 when compared to 2016. The increase in fastballs hit quality was shown solely on borderline batted balls while breaking ball and off-speed showed an increase of hit quality on a larger range of batted balls, similar to findings in a Tweet from Justin Verlander on March 1st. These data exhibit significant evidence that pitches that were not previously hit for home runs are now being hit for home runs.

The 2017 data shows many pitch types have a higher home run probability than previous years. One example is seen with slower fastballs moving away from the batter, which are up to 6% more likely to be hit for a home run. Another example is breaking pitches, which have become up to 3% more likely to be hit for a home run. On the other end, higher velocity fastballs with horizontal movement towards the batter were less likely to be hit for home runs. Finally, changeups with good rise have become harder to hit for home runs than in previous years.