

# The Increased Rate of Home Runs by Year in Major League Baseball

Pierce Thomas

*Albany State University, Albany, GA*

**Keywords:** baseball, home runs

Manuscript received on February 23, 2020; published in March, 2021.

**Abstract:** Looking at the last ten years and including the current year, there has been an increase in the number of home runs in major league baseball. This is especially the case with two of the last three years having records being set for single seasons home runs by the league. This is surprising because these records of recent years have been more than those of the steroid era. The second-place record broke the old record by nearly 500 home runs, and the current record of last season broke that record by over 600 home runs.

While there has not been a complete positive trend of an increase in home runs in the past ten years, there have been numbers put up that can compare with no other season. The last three years have had higher home runs per game by nearly 2.3, which is again interesting given that the players during the steroid era were not able to achieve such a stat line.

The purpose of this investigation is to try to determine what caused the spike in home runs and to give potential solutions to make the number of home runs trend back in the direction more representative of the ideal average.

## 1 Background

Baseball is considered by many to be America's national pastime. This game has been around since 1869, and over the years, the game has changed. The ideals and basis of the game have remained the same; but with new ideology, understanding, players, and play style, the game of baseball in today's world is far from what it was even ten years ago.

The premise of baseball can be boiled down to scoring more runs than the other team. The most efficient way to accomplish this goal is to have the hitter hit the ball over the fence. He is then awarded all four bases; thus, giving his team one run, (plus up to three more if the other bases had previous hitters on them). While home runs are exciting and very effective in giving teams runs, they were not the most common method of scoring. According to the Baseball Almanac, 5,042 home runs were hit in the year 2009. This is

compared to the 6,776 that were hit in 2019, or about 58 more home runs per team in the entire league [6]. This is the beginning and end of the trend, but in the years between 2009 and 2019, the rate of home runs increased slowly but surely until 2017, when there was a steep increase that has continued the last three seasons.

This rise in offensive power has been very good for the popularity of the league, especially in a time when the NBA and NFL are getting more attention across the nation. The question that is trying to be answered by not only the players, coaches, and fans, but also the head of baseball, is why has there been such an increase in home runs over the years, and what is causing the exponential growth over the past three seasons?

## 2 What is causing the increase?

Baseball Commissioner Rob Manfred decided to hire investigators to look into the home run situation and determine a possible cause for the change. A team of scientists (Table 1) conducted experiments to determine to what the rise in home runs could be attributed [1].

<ul style="list-style-type: none"> <li>• <b>ALAN NATHAN</b> (Chairman) - Professor of Physics Emeritus, University of Illinois</li> <li>• <b>JIM ALBERT</b> - Professor of Statistics, Bowling Green State University</li> <li>• <b>JAY BARTROFF</b> - Professor of Mathematics, University of Southern California (USC)</li> <li>• <b>ROGER BLANDFORD</b> - Professor of Physics, Stanford University</li> <li>• <b>DAN BROOKS</b> - Owner of BrooksBaseball.net</li> <li>• <b>JOSH DERENSKI</b> - Ph.D Student, Marshall School of Business, USC</li> <li>• <b>LARRY GOLDSTEIN</b> - Professor of Mathematics, University of Southern California</li> <li>• <b>PEKO HOSOI</b> - Professor of Mechanical Engineering, MIT</li> <li>• <b>GARY LORDEN</b> - Professor Emeritus of Mathematics, California Institute of Technology</li> <li>• <b>LLOYD SMITH</b> - Professor of Mechanical &amp; Materials Engineering, Washington State University</li> </ul>
--

Table 1. Members of the Committee studying home run rates in Major League Baseball.

One of their findings related to something that many people had speculated could be a cause, the baseballs themselves. There had been rumors and complaints from MLB pitchers that the balls used during the season had been “juiced” in order to make it easier for hitters to hit homeruns; thus, making the game more interesting to watch and giving the MLB more money. It was not known if this was being done intentionally or not, or even at all. In the report led by Jim Albert, there was not enough evidence to say definitively that the ball was the cause for the rise in home run levels. However, there was also not enough evidence to disprove the idea that the balls were the cause for change [1]. The Rawlings plant in Costa Rica, the MLB provider of baseballs, was under some scrutiny for changing the design of their balls between 2018 and 2019. This was taken into account in the investigation done by the MLB, but there was no definitive evidence to lean one way or another.

Even with the uncertainty, many players and fans find it difficult to explain the shift in correlation between home runs in the minor leagues and major leagues. According to Ben Lindeburgh and Rob Arthur, MLB sports writers, there has been a steady positive correlation between home runs in the minor leagues and home runs in the major leagues dating all the way back to 1990 [7]. In 2015, the minors and majors began using different baseballs and there has been a negative correlation in home run levels ever since.

Apart from the baseballs, there has been a different mindset and approach when it comes to hitting that may be a cause for more home runs. In today's game, pitchers are borderline unhittable. ESPN tells how in the 2019 season, the top 21 pitchers in opponent batting average, were all under .250. This means less than one out of every four hitters was getting a hit, making it very difficult for teams to string together base knocks and rally to score runs. They were better off gambling trying to hit a home run, which is a guaranteed one run minimum.

With this new mindset about hitting, baseball gave birth to a new wave of hitting style called *launch angle*, which can best be described as the trajectory at which the ball leaves the bat. Many players were under the impression that MLB fielders can field a ground ball and make a routine play. They also knew that a ball hit parallel to the ground had a 0% chance of going over the fence. Tom Verducci, MLB analyst, describes the idea of launch angle: "use a slightly upward path when swinging, hit the bottom third of the ball, hit the ball in the air no matter what" [11]. This style of play can be seen in players like Pete Alonso, who led the MLB in home runs in 2019 with 53, and Jorge Soler who was third in home runs in 2019 with 48.

This mindset of 'hit home runs, and swing for the fences' has also had the effect of more strikeouts. Since there are more strikeouts, there is a lower average among hitters overall. This phenomenon can be described with a simple statistic. In 2010, Josh Hamilton of the Texas Rangers hit .359. The closest anyone has come since is .348. Also, in the last two seasons the average leader in the national league has hit below .330, or .029 points lower than Hamilton. Undoubtedly the new style of play has had a lot to do with the new numbers that have spiked in the past ten years and last three in particular.

Another idea on the cause of change has been the weather. Olivia Miltner, ACCU weather staff writer, claims that part of the reason for the improved home run numbers can be associated with warmer weather [8]. With global warming being proven more and more every day, there is no doubt the air is warmer, thus making it less dense. Less dense air means the ball has less air resistance on it, making it travel further. A prime example of the effects of air density causing an increase in homeruns can be seen with the Colorado Rockies, the team that plays at Coors Field in Denver, well above sea level (by a bigger margin than almost any other field). The high elevation makes the air less dense; it has been proven that it is easier to hit home runs in this stadium. This can be backed by the fact that two of the three longest home runs that have been tracked have been at Coors Field, per USA Today [10]. Trevor Story hit a ball 505 feet, and Giancarlo Stanton hit a ball 504 feet, which coincidentally both occurred in the last three years, with the second longest home run between them taking place in 2016. Now that the planet is heating up, every stadium is becoming more and more like Coors Field. A study conducted by Tyler Ashoff, an MIT undergrad engineer, found that in the MLB, on days when the air was less humid or dense, that more home runs were hit [2]. He also found that in recent years, there have been more so-called 'low density air' days. Sports writer Wendy Trum also explains

how the increase in temperature has caused higher home run levels [9]. She focused her numbers on the temperature (in degrees Fahrenheit) and less on the air density, but the ideas go hand in hand. The summer months have had more 4+ home run games than any other month. The top ten games with the most home runs have been in summer months, all but one having a temperature above 70° Fahrenheit. This study was conducted in the 2012 season.

The issue with the increase in home runs is that the game is becoming inconsistent and ironically, slower paced. The strikeouts are not fun to watch, and there is less emphasis on what made the game so fun and strategy-driven in the first place. Baseball Commissioner Rob Manfred is looking to bring the game of baseball back to where it was before the home runs started going off the charts. There is a strong effort to normalize the game by finding the cause and fixing it. There are different solutions that could fix the problem, but the issue is picking the one with the least negative repercussions.

The ability or inability of the commissioner to do this impacts how the players and fans will enjoy the game for the future. Some like the old school nature of the game and want it to go back to how it was. Others like the newer play style and want the home run trend to continue even further. Manfred believes there is a happy medium that will satisfy both players and fans. He has a very difficult job at hand and that is why there have been so many different people looking into the cause. Once the cause is determined then the solution is that much easier.

### 3 Calculations to predict the future

In order to accurately represent the situation at hand, we first note the trend in annual home run totals, over the entire history of Major League Baseball, as shown by Ben Cooper in Figure 1 [4]. The data from 1901 to 2019, given in Table 2 ranges from a low of 245 in 1907 to a high of 6776 in 2019, with an overall steadily increasing upward trend [6].

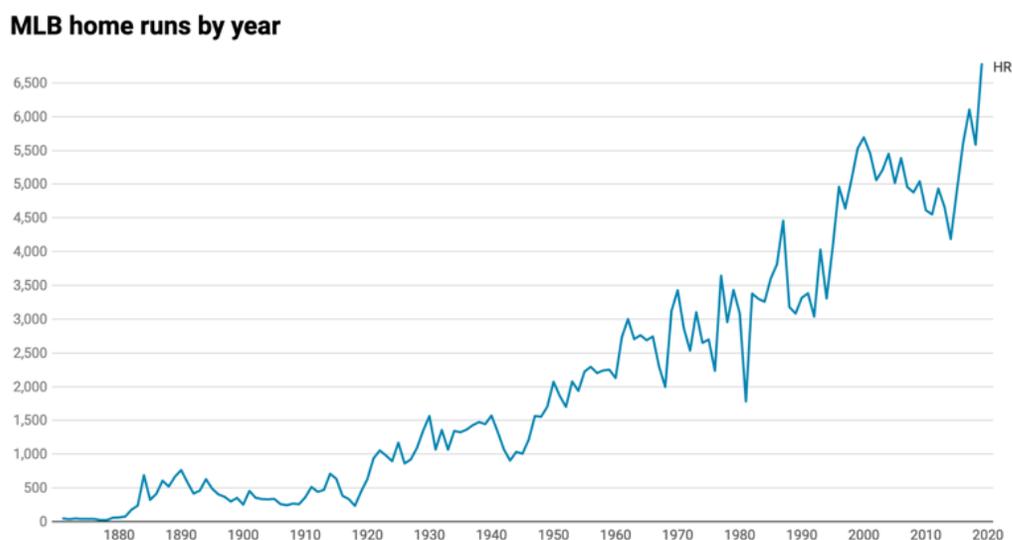


Figure 1. MLB home runs by year, 1859–2019. (Chart by Ben Cooper [4]).

Because the trend is ever more steeply increasing, an exponential model,  $y' = ky$ , with solution  $y = Ce^{kt}$ , is appropriate for predicting total home runs  $y$  in the years to come. One of the biggest jumps was from the year of 2018 when 5585 homeruns were hit to the year 2019 when 6776 homeruns were hit (1191 more).

If we set  $t = 0$  at year 2018, we can calculate  $C = 5585$ . Then for  $t = 1$  at year 2019, we use  $y = 6776$  and find  $k = 0.19330254$ . The calculations follow.

year	total MLB home runs
2000	5,693
2001	5,458
2002	5,059
2003	5,207
2004	5,451
2005	5,017
2006	5,386
2007	4,957
2008	4,878
2009	5,042
2010	4,613
2011	4,552
2012	4,934
2013	4,661
2014	4,186
2015	4,909
2016	5,610
2017	6,105
2018	5,585
2019	6,776

Table 2 Annual home run figures 2000–2019, from [6].

Using the data from 2018 and 2019, we start with

$$y = Ce^{kt}, \quad t=0, \quad y(0) = 5585.$$

This gives  $5585 = Ce^{k(0)}$ ,  $C = 5585$ , and  $y = 5585e^{kt}$ .

When  $t = 1$ ,  $y = 6776$ , so we now have

$$6776 = 5585e^k$$

$$6776/5585 = e^k$$

$$\ln(6776/5585) = \ln e^k = k$$

$$k = \ln(6776/5585) = 0.19330254$$

$$\text{Solution: } y = 5585e^{(0.19330254)t}$$

In Figure 2 we graph in red this solution function from 2010 to 2024 ( $t = -8$  to  $t = 6$ ) and compare it with blue data points for the MLB data in Table 2.

The graph of Figure 2 predicts that the number of homeruns each MLB season will increase. While it would be interesting to see 18,000 homeruns in a 2024 MLB season, this is not really possible. There is a limit to what people can achieve, as they are human after all, and the model could be calculated from a different pair of data points. However, with that said, there is a serious upward-facing trend that the graph does accurately model.

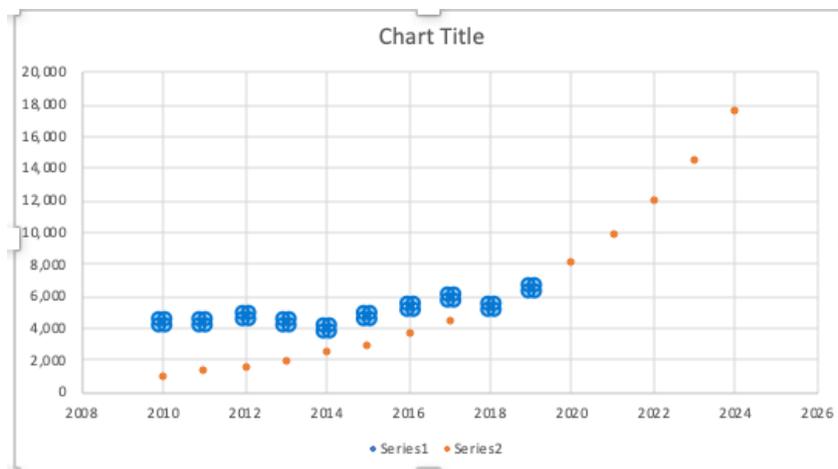


Figure 2. Potential number of home runs (red) in the MLB by year, compared with MLB data to 2019 (in blue).

## 4 Possible Ways to Harness the Home Runs

One very easy solution to this problem is raise the pitching mound. Ironically, the mounds used were raised in 1968 to promote more offense. The higher mounds gave the pitchers an opportunity to stride farther down the mound, thus decreasing the time the hitters had to react to the pitch as it was being released closer to the plate. There was also more of a plane created on the pitch which made it more difficult for the hitter to square a ball up. Lastly, breaking balls moved more as they have more time to drop and change direction making hitting that much more difficult. Raising the mounds again would lead to lower hitting stats all around, not just in home runs.

Another solution that may be more difficult is moving the mound closer by about two feet. An average MLB fastball is about 90 miles per hour, giving the hitter roughly 300 milliseconds to react and swing. Shortening the distance the ball has to travel between the mound and the plate will give the hitter less time to react (ten milliseconds less). The decreased reaction time makes hitting that much harder because there is already so little time to react in the first place.

These two solutions are the best possible because it is impossible to control things like the weather. They offer the ability to make changes over things that are manageable. The issue is not necessarily with the number of homeruns alone, but the negative aspects that come along with it.

The increased rate of home runs needs to be monitored because the game is becoming completely centered around homeruns. Currently there are people in the league who are not very good compared to other players, but they are strong and can hit homeruns, so they play. Fans wanted more offense, but all the homeruns have had the opposite effect and made the game more boring. Key elements of the game like stealing bases, situational hitting, and defense are all being neglected for the sake of hitting homeruns. The game is becoming either a home run or strikeout for a majority of 'at bats', which most fans find boring. Either of these possible solutions will make the game go back to how it used to be played and give

all aspects of the game an equal level of importance again; therefore, putting the thrill of the game back into baseball.

## References

- [1] Albert, Jim, et.al. (2018, May 24). Report of the Committee Studying Home Run Rates in Major League Baseball. [https://www.mlb.com/documents/7/9/4/278128794/Full\\_Report\\_of\\_the\\_Committee\\_Studying\\_Home\\_Run\\_Rates\\_in\\_Major\\_League\\_Baseball\\_052418.pdf](https://www.mlb.com/documents/7/9/4/278128794/Full_Report_of_the_Committee_Studying_Home_Run_Rates_in_Major_League_Baseball_052418.pdf).
- [2] Ashoff, Tyler. (2018). Understanding the Relationship between Weather Conditions and Homerun Rates in the MLB. <https://dspace.mit.edu/handle/1721.1/120271>.
- [3] Baseball Reference. (n.d.). <https://www.baseball-reference.com/>.
- [4] Cooper, Ben. (2019, Oct. 1). A Look into Major League Baseball's Massive Home Run Surge in 2019. *Capital News Service*. <https://cnsmaryland.org/2019/10/01/a-look-into-major-league-baseballs-massive-home-run-surge-in-2019/>.
- [5] Lahman, Sean. 2019 Pitcher Stats. *MLB Database*. <https://www.seanlahman.com/baseball-archive/statistics/>.
- [6] League by League Totals for Home Runs. (n.d.). <https://www.baseball-almanac.com/hitting/hihr6.shtml>.
- [7] Lindbergh, Ben and Rob Arthur. (2016, Jul. 20). Are Juiced Baseballs the New Steroids? <https://fivethirtyeight.com/features/are-juiced-balls-the-new-steroids/>.
- [8] Miltner, Olivia. (2019, Jul. 01). Is Weather Playing a Role in MLB's Record-setting Home Run Spike this Season? *Accuweather*. <https://weatherfanatics.blogspot.com/2017/08/is-weather-playing-role-in-mlbs-record.html>.
- [9] Trum, Wendy. (2012, Jun. 21). As Temperatures soar, so Do the Homeruns. *Fangraphs*. <https://blogs.fangraphs.com/as-temperatures-soar-so-do-the-home-runs/>.
- [10] Watch MLB's 10 Longest Home Runs of the Statcast Era. (2019, Aug. 02). USA Today Sports. <https://www.usatoday.com/story/sports/mlb/2019/08/02/mlb-longest-home-runs-statcast/1900372001/>.
- [11] Verducci, Tom. (2018, Mar. 21). Countdown to Liftoff. *Sports Illustrated*. <https://www.si.com/mlb/2018/03/21/evolution-swing-home-run-opening-day>.