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century. This debt stopped investments in Arkansas and deterred private investors from providing personal loans to farmers.

Arkansas has historically been reluctant to change and being so heavily invested in one crop in 1865, 1866, and 1867 crippled the state. The rest of the United States had moved toward industry, education, and manufacturing. In 1900, Arkansas was forty-fourth out of forty-eight states in the per capita value of its combined agriculture and manufacturing product. Although it ranked twenty-second in agricultural productivity, Arkansas was forty-sixth in manufacturing. Further, only 8.5% of Arkansans lived in towns with a population greater than 2,500.¹⁵ These numbers are the outcome of the Arkansas decision makers' faith in a crop and led to a lack of education and growth in other sectors.

In the national debate on slavery, Arkansas sided with the rest of the South and was pro-slavery. The belief in slavery and desire to keep the institution in place led directly to the Civil War. Emancipation hurt the Arkansas economy and cost farmers millions of dollars. Like most things, Arkansans were not ready for the change and fought against it. In 1865, whites were not willing to let go of free labor. Whites recognized the limitations on former slaves and took advantage of that. In some cases, slaves continued to work as slaves for years after the war. However, the free or cheap labor that was provided by these former slaves did not recover the massive losses experienced by slave owners. Those in power tried to hold onto slavery and put restrictions on African Americans. These limitations can be traced well into the 1960s and even to the present. The choices and attitudes of 1865 were a direct result of the faith and optimism of cotton and the agricultural way of life that made the state prosperous pre-war.

In recent years, Arkansas has had some success stories. However, the state still falls short in U.S. rankings. The reluctance to change is evident in every aspect of Arkansas, from education to government. Racism still lingers in areas of “The Natural State.” Arkansas’s reputation for lack of progress can be traced to 1865 when decisions were made that backpedaled the state. The very circumstances that made the Arkansas economy prosper pre-Civil War, cotton and the institution of slavery, helped withhold Arkansas from progressing. All development in Arkansas was centered around a fickle crop and a corrupt labor system, both fleeting things. The Civil War was devastating for Arkansas, and the events of 1865 gave an ironic insight into the future of the state.

Biographical Sketch

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Amusing Facts about the 500 Home Run Club

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¹⁵ *Twelfth Census, 1900 in, Moneyhon, Carl H., The Impact of the Civil War and Reconstruction on Arkansas, (Louisiana State University Press, 1994)265.*

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Abstract

Twenty-seven men have hit at least 500 major league home runs. Compilations of the list are common. But just showing that Willie Mays hit 660, and Mickey Mantle hit 536 gives only a small part of the story. There are wide variations in how the different players compiled their lofty totals. This paper examines some of those variations.

Acknowledgments

Before I begin, I want to thank two students, Dylan Howell and Eugene McNeely. These two gentlemen share two important traits with me: mathematical aptitude and love for baseball. After I had done the data mining, Dylan and Eugene were kind enough to go through the data to see where I made mistakes. Both found errors, and I appreciate the diligence and kindness that they showed in doing this while being slightly distracted by trying to graduate (Dylan) and becoming a father (Eugene). Any mistakes that may still end up appearing are my responsibility.

Introduction

Why do baseball fans like baseball? There are many different reasons. If I had to tell why I like baseball, I would be hard pressed to narrow it down to just two or three reasons. But one thing I love about baseball is the numbers. Since I am a mathematician that is likely no surprise. When I was in first grade, I came home upset one day. I had found out that I could calculate batting averages using long division. But they hadn't taught us to do long division yet (that was a fourth-grade thing). So my mother taught me how to do long division so I could do batting averages.

Modern sabermetrics has brought some heavy duty mathematical analysis into baseball. Oddly enough, I do not find that nearly as interesting as the same kinds of statistical observations I found interesting as a child. For instance, Earl Mack, son of Hall of Famer Connie Mack, ended his first season in major league baseball with a .500 batting average. But at the end of each of his two subsequent seasons, his average sat at exactly half of what it was at the end of the previous season.

Once I had a copy of it, I could spend hours poring through the pages of the Baseball Encyclopedia. All kinds of enjoyable nuggets can be found in those pages.

Recently I became interested in the members of the 500 home run club.

Name	HR	Name	HR	Name	HR
Barry Bonds	762	Harmon Killebrew	573	Ernie Banks	512
Hank Aaron	755	Rafael Palmeiro	569	Eddie Mathews	512
Babe Ruth	714	Reggie Jackson	563	Mel Ott	511
Alex Rodriguez	696	Manny Ramirez	555	Gary Sheffield	509
Willie Mays	660	Mike Schmidt	548	Eddie Murray	504
Ken Griffey	630	David Ortiz	541		
Jim Thome	612	Mickey Mantle	536		
Sammy Sosa	609	Jimmie Foxx	534		
Albert Pujols	591	Willie McCovey	521		
Frank Robinson	586	Frank Thomas	521		
Mark McGwire	583	Ted Williams	521		

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I started looking at how their lofty totals broke down into home and away totals, most versus particular pitchers or teams, and some other things. The following are some of those observations.

Home and Away

Baseball teams tend to do better at their home ballpark than on the road. The same may be expected of their players.

Players with the most home runs at home	
Hank Aaron	385
Barry Bonds	383
Alex Rodriguez	354
Babe Ruth	347
Jim Thome	339

Players with the fewest home runs at home	
Gary Sheffield	262
Ted Williams	248
Eddie Murray	242
David Ortiz	241
Eddie Mathews	238

Of course, these are almost the same as the top five and bottom five from the full list. So let's look at percentages of total home runs hit at home.

Players with the highest percentage of home runs at home	
Mel Ott	63.21%
Frank Thomas	59.88%
Ernie Banks	56.64%
Jimmie Foxx	55.99%
Jim Thome	55.39%

Players with the lowest percentage of home runs at home	
Eddie Murray	48.02%
Ted Williams	47.60%
Albert Pujols	46.87%
Eddie Mathews	46.48%
David Ortiz	44.55%

Jim Thome is the only man on both "top" lists. One might surmise that peculiarities about the home fields for Ott, Thomas, Banks, Foxx and Thome contributed greatly to their inclusion on the 500 home run list. And for Murray, Williams, Pujols, Mathews, and Ortiz, it may be that similar peculiarities kept them from being higher on the all-time list.

Right vs. Left

Traditional baseball wisdom says right-handed pitchers have an advantage against right-handed batters more so than against left-handed batters. Similar wisdom says left-handed pitchers are more likely to succeed against left-handed batters.

Most home runs versus right-handed pitchers	
Barry Bonds	535
Hank Aaron	534
Alex Rodriguez	524
Babe Ruth	499
Jim Thome	494

Least home runs versus right-handed pitchers	
Mickey Mantle	373
Ernie Banks	372
Eddie Murray	362
Frank Thomas	361
Mark McGwire	298

So let us look at numbers and percentages of career home runs versus right-handed pitchers.

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Highest percentage of home runs versus right-handed pitchers		Lowest percentage of home runs versus right-handed pitchers	
Ted Williams	87.72%	Frank Thomas	69.29%
Jimmie Foxx	82.02%	Willie Mays	68.33%
Eddie Mathews	81.64%	Reggie Jackson	68.21%
Willie McCovey	80.81%	Frank Robinson	66.89%
Jim Thome	80.72%	Mark McGwire	51.11%

Because the majority of pitchers are right-handed, it is no surprise that all of the players have a majority of their home runs against right-handed pitchers.

Now let us add in the handedness of the batters. Note that "B" denotes a switch-hitter, batting either right-handed or left-handed depending on the handedness of the pitcher.

Most home runs versus right-handed pitchers			Least home runs versus right-handed pitchers		
Barry Bonds	L	535	Mickey Mantle	B	373
Hank Aaron	R	534	Ernie Banks	R	372
Alex Rodriguez	R	524	Eddie Murray	B	362
Babe Ruth	L	499	Frank Thomas	R	361
Jim Thome	L	494	Mark McGwire	R	298

Highest percentage of home runs versus right-handed pitchers			Lowest percentage of home runs versus right-handed pitchers		
Ted Williams	L	87.72%	Frank Thomas	R	69.29%
Jimmie Foxx	R	82.02%	Willie Mays	R	68.33%
Eddie Mathews	L	81.64%	Reggie Jackson	L	68.21%
Willie McCovey	L	80.81%	Frank Robinson	R	66.89%
Jim Thome	L	80.72%	Mark McGwire	R	51.11%

Right-handed Jimmie Foxx having such a high percentage of his home runs against right-handed pitchers is peculiar, as is left-handed hitter Reggie Jackson having a comparatively low percentage against right-handed pitchers. I find it fascinating that Ted Williams hit only 64 of his 521 career home runs against left-handers.

Consistency

The only way to finish with 500+ home runs is to be amazingly consistent. Thirty home runs in a season is a good total. Let's look at the most and fewest years with 30+ home runs and the most and fewest consecutive years with 30+.

Name	years w/30	Name	consecutive years w/30
Alex Rodriguez	15	Barry Bonds	13
Hank Aaron	15	Alex Rodriguez	13
Barry Bonds	14	Albert Pujols	12
Albert Pujols	14	Jimmie Foxx	12
Mike Schmidt	13	Sammy Sosa	10
Babe Ruth	13		

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Name	years w/30
Mel Ott	8
Ted Williams	8
Gary Sheffield	8
Willie McCovey	7
Ernie Banks	7
Reggie Jackson	7
Eddie Murray	5

Name	consecutive years w/30
Ted Williams	4
Ernie Banks	4
Gary Sheffield	3
Eddie Murray	2
Reggie Jackson	1

There is no surprise that the men at the top of these lists are, for the most part, the men at the top of the career list. Mike Schmidt had one of the shorter careers of all of these players, explaining in part why he has so many 30+ seasons but isn't further up on the career list. Eddie Murray had very few 30+ seasons but had 11 other seasons in which he hit from 20 to 29. Probably my favorite note here is that Reggie Jackson never had consecutive seasons in which he hit 30 home runs. He had 29 home runs three different times. Had he hit one more homer in 1974, he would have had three consecutive 30+ seasons.

Against Teams and Pitchers

Some statistics will be dominated by players in a particular era because of changes in the game or by players based on whether or not they changed teams.

This chart shows the most home runs hit by each player against a single team. Babe Ruth hit 123 against the Tigers (and 108 against the Athletics). The top fourteen in this list played before expansion or played all (or almost all) of their careers in one league or both. Both of those characteristics mean more games against fewer teams, hence the chance to have a lot of home runs against an individual team.

Name	HR	Name	HR	Name	HR
Babe Ruth	123	Mickey Mantle	77	Manny Ramirez	55
Willie Mays	98	Eddie Mathews	76	Frank Robinson	54
Hank Aaron	97	Harmon Killebrew	75	Sammy Sosa	53
Jimmie Foxx	93	Willie McCovey	71	Rafael Palmeiro	52
Ted Williams	91	Alex Rodriguez	70	Frank Thomas	52
Barry Bonds	87	Jim Thome	66	Eddie Murray	44
Mel Ott	83	Reggie Jackson	62	Mark McGwire	43
Ernie Banks	82	David Ortiz	62	Ken Griffey	42
Mike Schmidt	78	Albert Pujols	56	Gary Sheffield	34

This next chart shows the most home runs by a player against an individual pitcher. The top is Willie Mays with 18 against Warren Spahn.

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Name	HR		Name	HR		Name	HR
Willie Mays	18		Ted Williams	12		Alex Rodriguez	8 %
Hank Aaron	17		Mike Schmidt	11		Ken Griffey	8
Babe Ruth	17		Frank Robinson	10		Albert Pujols	8
Jimmie Foxx	16 *		Manny Ramirez	10		Reggie Jackson	8
Ernie Banks	15		Jim Thome	9		Sammy Sosa	7 ^
Eddie Mathews	14		Harmon Killebrew	9		Mark McGwire	7
Mickey Mantle	13		Rafael Palmeiro	9		Eddie Murray	6 *
Mel Ott	13		Frank Thomas	9		David Ortiz	6
Willie McCovey	12		Barry Bonds	8 &		Gary Sheffield	6

& against five different pitchers

% against four different pitchers

* against three different pitchers

^ against two different pitchers

Again, most of the leaders played primarily in one league and/or before expansion. Additionally, the ones at the top of the list all played during the era when starting pitchers went into a game with the expectation of pitching nine innings.

It should be noted that Babe Ruth, with 13, and Jimmie Foxx, with 12, are the only ones to have 10 or more home runs against more than seven pitchers.

Last, let's look at the fewest home runs against another team for these players. Obviously, the fewest is likely to be 0. However, for six members of the 500-HR Club (Jim Thome, Sammy Sosa, Albert Pujols, Rafael Palmeiro, Manny Ramirez, Gary Sheffield) it is not zero since each has homered against every other team. To do that, a player would have to be on teams in each league or take amazing advantage of limited opportunities in interleague play. However, there are five who have hit at least 18 home runs against all other teams with which they have played. Not surprisingly, four of these men played for only one team. The other, Reggie Jackson, spent his entire career in the American League. Some, like Willie Mays and Ernie Banks, stayed in one league their entire careers; Mays, however, played a short time for a second team and neither was in the league long after the 1969 expansion.

Name	HRs
Mel Ott	59
Ted Williams	56
Mike Schmidt	32
Mickey Mantle	23
Reggie Jackson	18

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Most HRs with One Team

As expected, most of these players did not play for very many teams, though very few belonged to only one. This chart shows how many of the players played for how many different teams.

# of teams	# of players with that many teams
1	5
2	7
3	7
4	3
5	3
6	1
8	1

Obviously, then, the ones with only one team hit 100% of their home runs with that team. Some, like Mays, Aaron, Killebrew, and Mathews played only a minimal amount for another team, so their percentages are also quite high. Here we have the most HRs (and percentage of the whole) each player had with one team.

Name	HRs	Percentage	Name	HRs	Percentage
Hank Aaron	733	97.09%	Frank Thomas	448	85.99%
Babe Ruth	659	92.30%	Albert Pujols	445	75.30%
Willie Mays	646	97.88%	Ken Griffey	417	66.19%
Barry Bonds	586	76.90%	Mark McGwire	363	62.26%
Harmon Killebrew	559	97.56%	Alex Rodriguez	351	50.43%
Mike Schmidt	548	100.00%	Eddie Murray	343	68.06%
Sammy Sosa	545	89.49%	Jim Thome	337	55.07%
Mickey Mantle	536	100.00%	Frank Robinson	324	55.29%
Ted Williams	521	100.00%	Rafael Palmeiro	321	56.41%
Ernie Banks	512	100.00%	Jimmie Foxx	302	56.55%
Mel Ott	511	100.00%	Manny Ramirez	274	49.37%
Eddie Mathews	493	96.29%	Reggie Jackson	269	47.78%
David Ortiz	483	89.28%	Gary Sheffield	129	25.34%
Willie McCovey	469	90.02%			

While Ramirez played with five teams, almost all of his home runs came for his first two teams, Cleveland and Boston. In fact, he had none for Tampa Bay and only one for the Chicago White Sox. Jackson played for four with significant totals for three of them. Sheffield is the most interesting one here. He played with eight different teams but never very long with any of them, hence barely clearing 25% with his most productive tenure.

Our final chart continues the above theme. This will list the number of teams with which each player hit certain numbers of home runs. Obviously, the ones with only one team will not show much of interest here.

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Name	teams played for	teams with 200 +	teams with 100 +	teams with hit 50 +	teams with hit 10 +
Barry Bonds	2	1	2	2	2
Hank Aaron	2	1	1	1	2
Babe Ruth	3	1	1	1	2
Alex Rodriguez	3	1	3	3	3
Willie Mays	2	1	1	1	2
Ken Griffey	3	2	2	2	2
Jim Thome	6	1	3	3	4
Sammy Sosa	4	1	1	1	4
Albert Pujols	2	1	2	2	2
Frank Robinson	5	1	2	3	5
Mark McGwire	2	2	2	2	2
Harmon Killebrew	2	1	1	1	2
Rafael Palmeiro	3	2	2	2	3
Reggie Jackson	4	1	3	3	4
Manny Ramirez	5	2	2	2	3
Mike Schmidt	1	1	1	1	1
David Ortiz	2	1	1	2	2
Mickey Mantle	1	1	1	1	1
Jimmie Foxx	4	2	2	2	2
Willie McCovey	3	1	1	2	2
Frank Thomas	3	1	1	1	3
Ted Williams	1	1	1	1	1
Ernie Banks	1	1	1	1	1
Eddie Mathews	3	1	1	1	2
Mel Ott	1	1	1	1	1
Gary Sheffield	8	0	2	4	8
Eddie Murray	5	1	1	3	4

Conclusion

I have enough data for many more pages, indeed, perhaps a short book. But this gives an idea of the kind of amusement I find in baseball statistics.

Biographical Sketch

Fred Worth received his B.S. in Mathematics from Evangel College in Springfield, Missouri in 1982. He received his M.S. in Applied Mathematics in 1987 and his Ph.D. in Mathematics in 1991 from the University of Missouri-Rolla. He has been teaching at Henderson State University since August 1991. He is a member of the Society for American Baseball Research and the Mathematical Association of America. He loves the Mets and hates the Yankees.