By the Numbers

Volume 27, Number 1 The Newsletter of the SABR Statistical Analysis Committee July, 2017

Review

Academic Research: Umpires, Jet Lag, Options

Charlie Pavitt

The author reviews three recent academic papers: one investigating how batters adapted to strike zone changes; one on how jet lag affects teams; and one on whether variability increases option costs in MLB as it does in financial markets.

Mills, Brian M. (2017), Policy changes in major league baseball: Improved agent behavior and ancillary productivity outcomes, Economic Inquiry, Vol. 55 No. 2, pp. 1104-1118.

The presence of PITCHf/x data has allowed for detailed examination of home plate umpire performance, and the findings have been instructive. Among other findings, Jon Roegele in the 2014 *Hardball Times Annual* noted a significant increase in the number of low strikes called by umps between 2008 and 2013. Mills replicated this observation, concluding that the average strike zone had expanded on the bottom by three inches between 2008 and 2014, resulting in three times as many called strikes in the zone between 18 and 21 inches off the ground.

Both pitcher and batters appear to have noticed the change, with the proportion of pitches in that zone increasing from about 22 percent to about 27½ percent, and swings on pitches in that zone from about 31 percent to about 34½ percent. This change favors the pitchers, as when a batter swings at pitches in that zone, the odds of making content are 73 percent lower than for pitches above it. The batter has also 48 percent lower odds of putting the ball in play, and 26 percent lower odds of getting a hit.

Using Retrosheet data, Mills noted a relationship between this change and run production per game over this interim.

Song, Alex, Thomas Severini and Ravi Allada (2017, February 7), How jet lag impairs major league baseball performance, Proceedings of the National Academy of Sciences of the United States of America, Vol. 114 No. 6, pp. 1407-1412.

There have been a few studies of the impact of cross-country travel over the years, with a general finding that the more time zones crossed, the worse the traveling team's performance in the first couple of games of a series. It has been noted that home team advantage increases when the traveling team has traveled east to west, but is particularly strong when the travel is west to east.

Song, Severini and Allada (2017) reiterated that claim from earlier work, and replicated it for home teams using 1992-2011 data. They found the home field advantage was nullified for teams returning home west-to-east through either two or three time zones when the visiting team had stayed in the same time zone; the analogous effect for home teams traveling east-to-west also occurred but more weakly. Home-team slugging average, and even more specifically number of doubles hit, were affected identically, as were slugging average by opposing team, runs allowed, and fielding-independent pitching, the latter two due to giving up more home runs.

In this issue

The previous issue of this publication was December, 2016 (Volume 26, Number 2).

Gross, Alexander and Charles Link (2017), Does option theory hold for major league baseball contracts, Economic Inquiry, Vol. 55 No. 1, pp. 425-433.

Gross and Link likely began a new area of study in examining the factors that motivate teams to seek team options for seasons included in free agent contracts. They restricted their sample to 109 circumstances in which position players eligible for free agency signed new contracts between 2003 and 2011, with those contracts either including team options or performance standards that needed to be reached for additional years to vest.

Using performance data from Retrosheet, the authors discerned that team options/performance standards were more likely to be included in proportion to the extent that the player had been inconsistent in OPS over the past three seasons. That makes sense, as such players were thought to be riskier investments than more consistent players.

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Pitcher Batting Eighth: Two Studies

Mark Pankin

Last issue, Pete Palmer had a study on the effect of pitchers batting eighth instead of ninth. Here, Mark Pankin summarizes his earlier work on the same question.

In an article in the December, 2006 issue of BTN, Pete Palmer studied pitchers batting eighth rather than ninth. He used a Markov model for his analysis, which has become one of the standard tools for evaluating batting orders. I have done two studies on this topic, which are quite a bit different from Pete's work. Both of these were presented at SABR conferences and are available on the Retrosheet web site research page.

Who's Right: LaRussa or Gant? (SABR 29, 1999)[1]

Pete said that the 1998 Cardinals were the first team to significantly utilize the strategy, giving 162 at-bats to pitchers in the number eight slot. Tony LaRussa, the team's manager, said he did it to help Mark McGwire who was in a race with Sammy Sosa to see who could first break Roger Maris's 61 home run record. LaRussa's thinking was that with a position player hitting ninth, it would be more likely there would be men on base when Big Mac came up to bat in the number three slot. If so, the other teams would be less likely to walk him.

After Ron Gant moved from the Cards to the Phillies following the 1998 season, he argued that while batting the pitcher eighth may have helped Big Mac, it hurt the team. Instead, he said McGwire should have been moved down to the cleanup position.

To test these hypotheses, I used my version of the Markov model that allows for each players' batting data rather than using overall averages by lineup position.

My conclusion was that batting the pitcher eighth did not make much have much effect on the team's run scoring, but it may have put a few more men on before McGwire's plate appearances. Moving McGwire to cleanup would not have affected the scoring either, but over the course of a season, it would cost McGwire about 18 opportunities at the plate. Given his home run rate that season, that likely would have reduced his total by one to three.

As part of the study, I used the model to try to find the worst possible batting order for the Cards. Since the model is designed to find ones that perform well, there is no assurance that the worst it produced is the true worst. However, it was pretty bad -- about 50 runs a year fewer than the best ones. That lineup, not surprisingly, had Big Mac last, and the pitcher in the cleanup spot.

Should Pitchers Bat 9th? (SABR 37, 2007)[2]

Even before Pete's study, there have been several analyses of this question. Some of them have found that batting the pitcher eighth would increase scoring a little, and batting him seventh might help a little more. The idea is to increase the chance that there are runners on when the team's better hitters at the top of the lineup come to bat. The tradeoff is the increased chance that a rally in the first or second inning could be cut short.

All of these studies, like Pete's, assume a constant lineup through the game. I decided to approach it a bit differently. Pitchers now rarely hit every time through the lineup, so I considered that it might a good idea to have the replacement hitter—a pinch hitter or someone coming in on a double switch—come up in the eighth slot. On many teams the potential pinch hitters are better hitters than the typical number eight batter. I used my Markov model to look at each NL team in 2006. To look at an extreme case as a way of testing my concept, I also assumed the replacement hitter would be Ted Williams cloned from 1941.

[1] www.retrosheet.org/Research/PankinM/larussa.pdf

[2] www.retrosheet.org/Research/PankinM/Pankin-sabr37.pdf

It turned out that my underlying hypothesis was not correct. The better the potential replacement hitter the more it hurt the team not to bat the pitcher ninth. The only exception was the 2006 Cardinals, but the improvement was tiny, less one run over 162 games. That's because, that season, the St. Louis replacement hitters were much worse, with regard to both on-base percentage and slugging average, than their number eight batters.

Once again, the essential result is that it doesn't make much difference if the pitcher bats eighth or ninth. However, in a truly optimal lineup, there may be an advantage of perhaps one win a year to having someone other than the weakest hitter bat last, to give the ones at the top of the lineup a better chance of driving in runs. Some of my other studies have shown that the difference between the theoretical scoring of typical lineups and optimal ones is not great, perhaps one win a year for most teams. That is particularly true since teams have realized that the largest gains come from having higher on-base percentage hitters at or near the top of the order.

Beyond that, the managers' insights and strategic considerations (such as not having too many left-handed hitters bat consecutively), are generally worthwhile.

Mark Pankin, sabr@pankin.com ♦

Combination Career Leaders

Tom Hanrahan

*Pete Rose can say that nobody in the history of MLB has more hits than he does. But is there anyone in baseball who can say, there are players who may or many not have more hits than me, and there are players who may or many have more RBI than me, but there is nobody who has more of **both**? The answer: for this combination, no. But what about other sets of statistics?*

When discussing all-time great baseball players, often we refer to leaders in important categories. For example, Ty Cobb hit .366 for his career, topping all other players, and Babe Ruth slugged .690, which dwarfs everyone else. These are simple and effective arguments to make. However, everyone knows there are great players who excelled in more than one category, and to limit "greatness" to single measurements is to fail in recognizing all-around ability.

Statistically defining a truly well-rounded great player is an art, as the combinations which can be chosen are almost boundless. The more "well-rounded" a player is claimed to be requires increasing the number of categories, and the possible combinations expand more exponentially than linearly. For example, if I wished to claim that player X was amazing because no one else at his fielding position had more RBI, more gold gloves, and more SB than he, that's a nice claim, but it could be true of multiple people. And at 7 other positions, and in a gazillion other sets of 3 categories. Completing such a set of people about who the above claim is true could end up defining hundreds of players, which no longer allows us to claim "greatness."

So I began this project on a small scale. First, by determining the most important categories for MLB hitters, and noting the leader in each. Next, by trying every combination of two categories, and finding all players who could say, "While I am not the all-time leader in any one key statistic, no one can say they had more X *and* Y than I did." In other words, a player who was ranked so high in two different statistics that anyone who topped him in one stat, was lower in the other. Starting even with a limited set of statistics, there are so many ways to combine them into two categories, I guessed that many players might be "two-statistic leaders."

The first task was to choose the categories. I decided that they should be

A mix of rate statistics and compiling statistics;
Commonly understood and quoted
Be of significant value
Not overly duplicative

I began with the classic triple crown stats; batting average (AVG), home runs (HR), and runs batted in (RBI). The other common and important rate stats are generally agreed to be on-base percentage (OBP) and slugging percentage (SLG); this pretty much covers the gamut of greatness per plate appearance. Adding runs scored as the partner to RBI is another natural addition.

One last common statistic is simply "hits"; and it is true that Pete Rose is well known as the all-time hits leader. But again, it is hard to justify H and not also include total bases (TB) or times on base (hits plus walks + HBP).

So to begin with, I used those six statistics. Fascinatingly, 6 different men hold the MLB records for leading these 6 categories:

AVG -- Ty Cobb
OBP -- Ted Williams
SLG -- Babe Ruth
HR -- Barry Bonds
R -- Rickey Henderson
RBI -- Hank Aaron

Having six different leaders was not the state throughout most of MLB history, where often the same player was the career leader in multiple categories, but as of spring 2017 and the near future, none of these records are in jeopardy.

Obviously, all six would also be leaders in combinations of two; no one can say they hit more home runs *and* a higher batting average than Cobb, since he already has the highest AVG.

There are 15 ways to create combinations of 2 stats from 6. In probability theory, this is known as "6 choose 2", and described in equation form as 6! / (4! * 2!) = 6*5/2 = 15. So my research was to answer the question: Of these 15 combinations, how many men besides the 6 category leaders could be found to have no one surpass them in any 2 categories?

The answer: just one! And, even more surprisingly, it's not one of the six! Interested readers might want to stop and guess who it might be before proceeding.

Why just one? Well, in spite of 15 possibilities, many of the career leaders here also finished in the top view in most other statistics. For example, Babe Ruth was the greatest slugger (SLG), but he also scored a ton of runs (R), drove many in (RBI), and reached base often. So, as it turns out, it's really hard to beat Babe Ruth in almost any combination of categories. Below is a table of where our 6 stat leaders fall in the other stats; their totals are listed, and if they are in the top 10 of career leaders, their rank is given in parentheses:

	AVG	OBP	SLG	HR	R	RBI
Cobb	.366	.433 (9)	.500	117	2244 (2)	1933 (8)
Williams	.344 (8)	.482	.634 (2)	521	1798	1839
Ruth	.342 (10)	.474 (2)	.690	714 (3)	2174 (4t)	2214 (2)
Bonds	.298	.444 (6)	.607 (5)	762	2227 (3)	1996 (5)
Henderson	.279	.401	.419	297	2295	1115
Aaron	.305	.374	.555	755 (2)	2174 (4t)	2297

There is only one player who finished ahead of these 6 men (and all others) in any combination of two categories. That man is… Rogers Hornsby. Combining batting average with any of 3 different categories; on-base percentage, slugging percentage, and home runs; yield results where Hornsby can say "no one beat me in both" of those.

	AVG	OBP	SLG	HR	R	RBI
Hornsby	.358 (2)	.434 (8)	.577 (4)	301	1579	1584

The answer surprised me. I had expected to find many more such players. Well, there was almost a second one -- Shoeless Joe Jackson also has a higher AVG and SLG than the six men above, but Hornsby tops Jackson in both of those.

Would we find more names if we allowed for any (there are 20 possibilities) combination of three categories? Answer: no, not that I could find with these 6 stats. The search process, done by hand, gets more complicated.

If we chose different statistics, we can come up with many more leaders. Rose, as previously mentioned, is the Hit King. If we added total bases (TB), Stan Musial (who is 2nd all time) can claim no one bests him in both TB and AVG (or OBP, or SLG). Willie Mays could use TB to create a three-category domination of TB, HR, and either OBP or SLG.

If we use stolen bases, we pop up more combination leaders. Some would argue SB are an overrated category, but throughout much of MLB history steals have gained much notice. Rickey Henderson is (by far!) the all-time SB leader, but Lou Brock can say no one beats him in SB (2nd all time) and AVG. Similarly, Billy Hamilton (3rd in SB all time; the "Sliding Billy " of the 19th century, as opposed to the current MLB player who has trouble getting to first) dominates if we use SB and any one of AVG/OBP/SLG. Using SB also allows Alex Rodriguez to be a three-category leader: no one tops him in SB plus any two of (R, HR, RBI). Mays and Musial also have 3-category dominations.

Obviously, these are all purely offensive categories. If we began to count gold gloves, or by fielding position, an enormous set of combinations would be possible; we would see Honus Wagner, Mike Piazza, Mike Schmidt, and a host of other names. This might produce an interesting set of well-rounded leaders, but if we stick to the major batting categories, there are only 7 men who lead in either one category, or would be leaders of a combination of 2 more of them. And each of these men; Cobb, Ruth, Hornsby, Williams, Aaron, Henderson, and Bonds; have been thought by many to be the most dominant offensive forces in the history of major league baseball.

Tom Hanrahan, han60man@aol.com ♦

Pinch Running: Each Era Tells a Different Story

Samuel P. Anthony

In the last issue of BTN, Bill Deane looked at the empirical results of pinch running in World Series games from 1970 to 1989. Here, the author looks at 1990 to 2015, and finds at best a marginal improvement in these more recent years.

This article continues the work that Bill Deane and I have been doing in regards to the use of the pinch runner.

Deane started the conversation in the March 2016 issue of *By the Numbers* (BTN) when he published his article titled "Pinch-Running on Empty," in which he discussed pinch-running situations spanning World Series games from 1970 to 1989. From his work, Deane surmised that the strategy of pinch-running may have more cost than benefit. He concluded that over those 20 Series, pinch running had gained 1 run while costing 4.3 runs.

I added my own spin to the study when I took it upon myself to examine further and look at pinch runners from 1990 to 2015, which at the time was the most recent World Series. I took a much different take on his study, going beyond the face value of simply crediting a pinch runner as a successful when he scored. I attempted to find value in the strategy of using the pinch runner, even if that runner did not actually cross the plate. The idea was that if I was able to determine that the pinch runner helped improve the team's chances of scoring, then the strategy was considered successful.

Now while Deane had 71 pinch running situations, I had 59. Deane considered 12 of his 71 successful. I was able to deem 19 of my 59 runners as successful, a 35.9 percent success rate, compared to the 16.9 percent rate that came from Deane's study.

At face value, it looked as though there was a significant difference between the time periods' pinch-running success, but then I took a second look with some situational analysis. Looking closer at those 19 situations I deemed as "effective", I was only able to confidently say that 11 of those situations were successful due directly to the pinch runner. That brought my success rate down to 18.6 percent. Which, even though it was still higher than the 1970-1989 era, was not a significant difference.

I concluded that, if done correctly, pinch running could be a very effective tool in gaining slight advantages in the regular season and winning key games that could be the difference in getting a playoff berth or even winning the World Series.

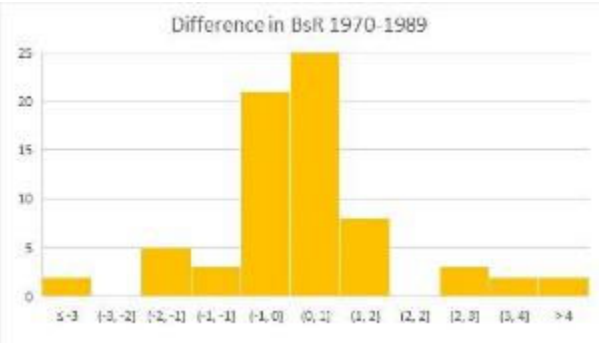
While Deane and I did not exactly see eye to eye in our perspective of the pinch runner, we were able to collaborate in another article in this issue -- Deane's piece *Pinch Running on Empty, Redux.* There, Deane talks about our further investigation into how much credit we can give pinch runners from 1970-2016, looking further into the 27 scenarios in which a pinch runner was able to come around to home plate and whether their speed and baserunning ability was a credible factor in the scoring of the run, or whether the replaced runner would have also been able to score.

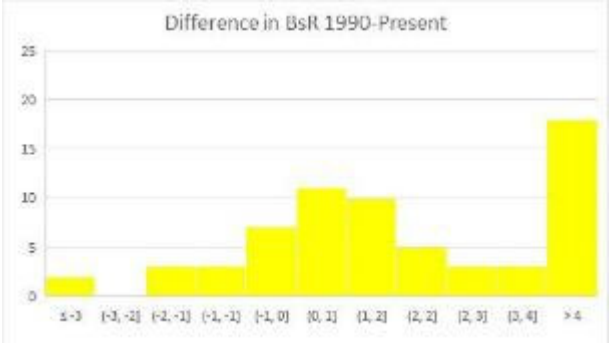
The combined results were that when you combined all the successes and failures of pinch runners, there was a net loss of 2.72 runs. Negative runs are clearly not the goal if you want a strategy to win more ball games. But both Bill and I believe that we are just cracking the surface on the topic of the pinch runner, so I have decided to try and dig a little bit deeper, looking at some data and seeing what it will tell me.

Have we seen any improvement over time?

First, I continued what I had done in my article and used the metric BsR, which I had used in my previous article, and applied that to Deane's data. Once completed, I divided them into histograms to determine if there were any trends in the data.

The first histogram looked at the difference in BsR between the pinch runner and the replaced runner, investigating whether either era (1970-1989 or 1990-Present) saw more pinch running situations in which the runner being put into the game was significantly better than the replaced runner, or if the baserunning ability of each time period was generally the same.





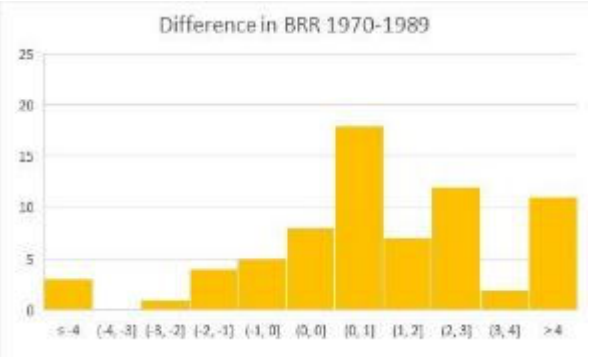
These graphs show clearly that the 1990-2016 era saw far more significant BsR shifts, including 18 instances where the pinch runner was more than 4 BsR over the runner he replaced. Compare that to the 1970-1989 period, which saw mostly minimal improvement within 1 BsR. In fact, from 1970-1989, out of the 71 pinch running scenarios, only 7 situations saw a BsR improvement of over 2.

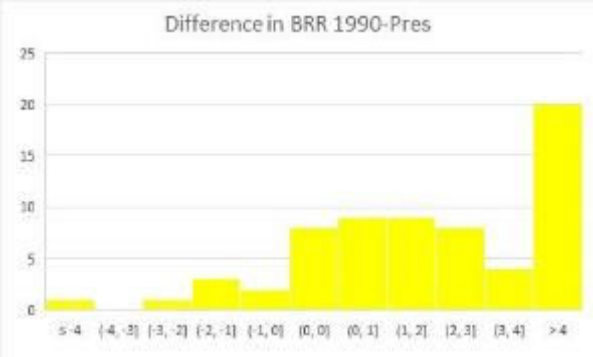
The insight that these graphs provide is perhaps an explanation behind the increase in success from Deane's study to my own -- that managers are inserting better baserunners, resulting in improved results and perhaps a potential benefit from the strategy of pinch running.

It's common sense that putting in a runner that is only slightly better than the current runner will not create benefits that outweigh the current costs. But if you insert a substitute who is almost twice as skilled on the basepaths as the current runner, the benefits of that move being made 100 times will create far more successes than failures, improving a team in the long run and potentially in the moment where they need one crucial run the most, like in a World Series game.

But since there is more than one way to rate a baserunner, I decided to also use the BRR rating, a statistic used by *Baseball Prospectus*[1]. The idea of using an additional metric is to provide support to the claim made above.

The distribution of BRR is somewhat different from BsR:





With BRR, there is less variance in the difference between the data. Both histograms are skewed to the left and show that, for the most part, the substitution decisions by the managers were good ones, putting in much more talented base runners compared to those before them.

For the 1970-1989 graph, almost half of the pinch runners wound up within the range of 0 to 1 in terms of improvement, showing only a slight improvement in the skill of the player on the bases. Compare that to the 1990-2016 graph, which sees 20 of its 71 total situations display a shift in skill to a player that produced +4 or more runs total that season from their baserunning.

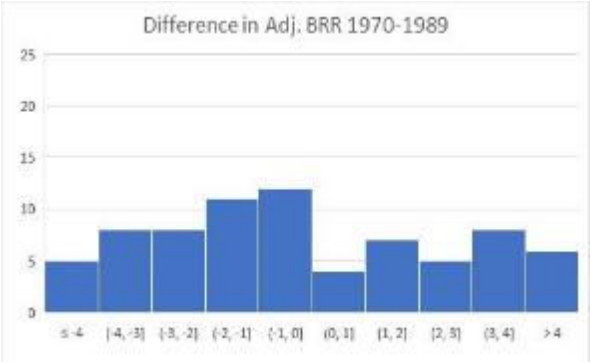
[1] An abbreviation for "baserunning runs," Baseball Prospectus says BRR "measures the number of runs contributed by a player's advancement on the bases, above what would be expected based on the number and quality of the baserunning opportunities with which the player is presented, park-adjusted and based on a multi-year run expectancy table."

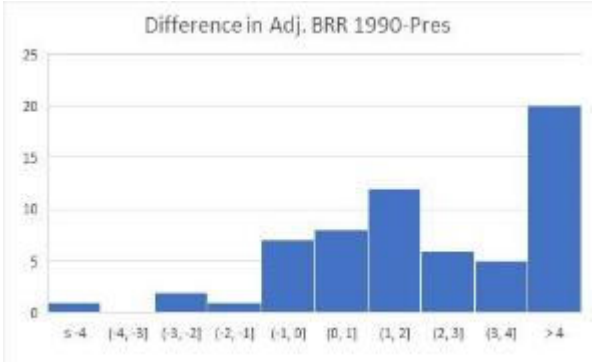
Despite the shift for the 1970-1989 time period, the idea still remains the same; the 1990-Present era has far more pinch running situations which saw a large improvement in the speed of the pinch runner. This supports the earlier claims that the use of the pinch runner has improved over time to become more efficient.

Normalizing the Data

To confirm the accuracy of my data, I normalized the BRR of every single player in the data set for 150 times on base. That's because there may be players who don't play regularly, or who are used predominantly as pinch runners, so their lower BRR numbers may not do justice their ability on the basepaths, due to their limited appearances on the bases and in games. (Herb Washington of the Oakland Athletics, who was used exclusively as a pinch hitter and never came to the plate, is an extreme example of such a player.)

The normalized results confirm what the previous data was already suggesting:





While the data from 1990 to the present stayed relatively the same in shape, the data from 1970-1989 actually made a change for the worse, with more pinch running situations resulting in a negative shift in BRR.

Conclusion

As of the data analyzed to date, all signs suggest an improvement over time in decision-making when it comes to pinch running. Which in turn continues to suggest that eventually pinch running has the capability, if used the correct way, to be a tool managers can use to gain an edge in tight games.

To truly determine the effectiveness of the pinch runner, a more in-depth study will have to be executed through the entirety of regular season play, to get a larger pool of data. From there, the first step needs to be determining whether the trend over time has been towards improved pinch running. It is logical that better base runners make the strategy more effective.

Another suggestion for future research is to evaluate which runners are best used in these situations. Could limiting substitutions to the fastest runners, relatively, be the best choice in making pinch running a strategy which changes the landscape and results of a game?

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Back issues

Back issues of "By the Numbers" are available at the SABR website, at http://sabr.org/research/statistical-analysis-research-committee-newsletters, and at editor Phil Birnbaum's website, www.philbirnbaum.com .

The SABR website also features back issues of "Baseball Analyst", the sabermetric publication produced by Bill James from 1981 to 1989. Those issues can be found at http://sabr.org/research/baseball-analyst-archives.

Submissions

Phil Birnbaum, Editor

Submissions to *By the Numbers* are, of course, encouraged. Articles should be concise (though not necessarily short), and pertain to statistical analysis of baseball. Letters to the Editor, original research, opinions, summaries of existing research, criticism, and reviews of other work are all welcome.

Articles should be submitted in electronic form, preferably by e-mail. I can read most word processor formats. If you send charts, please send them in word processor form rather than in spreadsheet. Unless you specify otherwise, I may send your work to others for comment (i.e., informal peer review).

I usually edit for spelling and grammar. If you can (and I understand it isn't always possible), try to format your article roughly the same way BTN does.

I will acknowledge all articles upon receipt, and will try, within a reasonable time, to let you know if your submission is accepted.

Send submissions to Phil Birnbaum, at philbirnbaum@outlook.com.

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Pinch Running on Empty, Redux

Bill Deane

Two issues ago, author Bill Deane studied the effects of World Series pinch-runners from 1970 to 1989. Last issue, Samuel Anthony studied 1990 to 2015, where he checked whether the pinch runner gained his team bases. Here, the author revisits the time period Anthony studied, but with an eye to checking whether the substitution gained the team runs.

In the March, 2016 edition of *By the Numbers*, I presented a small study on the effectiveness (or lack thereof) of pinch-runners, examining 1970-89 World Series play-by-play. It indicated, based on that small sample size, that the strategy was generally not worthwhile.

Samuel P. Anthony followed in the December, 2016 issue of *BTN* with his study of 1990-2015 World Series pinch-runners, which found more positive effects.

Since then, we have spent a lot of time exchanging notes and data from the two periods, resulting in a joint database now covering 46 World Series (1970-2016; no Series in 1994) and 264 games. This is a summary of our findings, with some repetition from the past articles.

My study looked only at situations where the runner wound up scoring (isn't that the purpose of a pinch-runner?), whereas Anthony's included other incidents where the runner theoretically improved his team's chance of scoring, even if he did not ultimately cross the plate. If a pinch-runner stole second base with two out, then was stranded there, Anthony would say that the *runner* did his job in improving his team's chance to score (from .209 potential runs to .348, based on Pete Palmer's run expectancy tables). I would say that the *strategy* accomplished nothing, as the original runner would have been stranded just as the pinch-runner was, just at a different base; we don't need potential runs when we have actual runs. We'll let you see both results so you can decide for yourself.

Anthony also did not examine the theoretical negative effects of pinch-runners, as I did: How often does a pinch-runner – perhaps not warmed-up enough, or being over-aggressive to justify his role – get caught stealing or otherwise retired trying to take an extra base? And how often does the replaced player's spot in the batting order come up again, with a weaker batter in his place? With Anthony's considerable help, I have calculated these residual damages for the whole 46 years.

There were 136 pinch-running substitutions in those 46 years. Only 27 of the runners wound up scoring, or just under 20%. I tried re-creating the innings in those 27 cases, hypothetically assuming the baserunner was not replaced and would neither have advanced nor tried to advance any more bases than the following batters (unless the evidence was persuasive to the contrary). This is harder than it sounds; there have been a lot of cases, especially since 2000, where the answer was not cut-and-dried. I tried to be objective, and to come to consensus with Anthony, but don't expect you to take my (or our) word for it, so here are the 27 cases, plus some others of interest:

World Series Runs Scored by Pinch-Runners, 1970-2016

1971, Game 2: Baltimore's Paul Blair ran for Frank Robinson at first base in the sixth inning with none out (rather than a strategic move, this would appear to be giving Robby, a fine baserunner, the rest of the day off; the O's had a 10-0 lead at the time). Elrod Hendricks singled to left, with Blair advancing to third. Brooks Robinson singled to center, scoring Blair and sending Hendricks to second. Davey Johnson struck out. Mark Belanger grounded to Pirates' second baseman Dave Cash, who stepped on second to force Brooks Robinson, with Belanger reaching first and Hendricks moving to third. Jim Palmer grounded to first to end the inning. Conclusion: Frank Robinson would have scored, even if he had stopped at second on Hendricks's single, and at third on Brooks Robinson's, since Hendricks ultimately wound up at third base.

1972, Game 4: Oakland's Allen Lewis ran for Gonzalo Marquez at first base with one out in the ninth inning. Gene Tenace singled to left, with Lewis stopping at second. Don Mincher singled to right-center, scoring Lewis with Tenace going to third. Angel Mangual singled through the right side of a drawn-in infield to score Tenace with the winning run. Conclusion: Marquez would have scored, even if he stopped at third on Mincher's hit, since another hit followed that one (but if the plodding Tenace could get to third, Marquez would have scored anyway).

1972, Game 7: Oakland's Allen Lewis ran for Gene Tenace at second base with two out in the sixth inning. Sal Bando doubled over Reds' center fielder Bobby Tolan's head, scoring Lewis. A walk and error followed before the final out. Conclusion: Tenace would have scored on Bando's two-bagger.

1973, Game 2: Oakland's Allen Lewis ran for Deron Johnson at second base with none out in the ninth inning. Bert Campaneris struck out. Joe Rudi grounded to third, Lewis holding second. Sal Bando walked. Reggie Jackson singled to right, scoring Lewis and sending Bando to third. Gene Tenace singled to left, scoring Bando, with Jackson stopping at second. Jesus Alou grounded out to end the inning. Conclusion: Even if he didn't score on Jackson's single, Johnson would have scored on Tenace's.

1978, Game 5: The Yankees' Paul Blair ran for Mickey Rivers at first base with two out in the seventh inning with Denny Doyle on third. (Rivers was the Yankees' fastest runner, but Blair was a better outfielder. Manager Billy Martin liked to pinch-run prior to making a defensive replacement, to get the new player warmed up.) Roy White singled to right, scoring Doyle, with Blair stopping at second. Munson doubled to deep left-center, scoring Blair and White. Reggie Jackson grounded out to end the inning. Conclusion: Rivers would have scored easily on Munson's double.

1979, Game 4: The Orioles' Rick Dempsey ran for Terry Crowley at third base with one out in the eighth inning (Tim Stoddard was on first). Al Bumbry grounded to Pirates' shortstop Tim Foli, who tossed to second base to retire Stoddard on a force, with Bumbry reaching and Dempsey scoring. Kiko Garcia struck out to end the inning. Conclusion: Crowley would have scored just as Dempsey did.

(Incidentally, while reviewing the 1970-89 play-by-play to address Anthony's premise, I did come across one play where a pinch-runner did not score, but nevertheless may have had a profound impact on the game. In the 1980 Series, Game Five, the Phillies' Lonnie Smith ran for Greg Luzinski at first base with one out in the seventh inning. Keith Moreland then reached on what was scored as an infield hit to shortstop, as the force-out attempt at second failed. It's likely that the lumbering Luzinski would have been forced out in that situation so, even though Smith didn't wind up scoring, he gave the Phillies an extra out to work with. The Phillies did win the game in the ninth, on a two-out hit by Manny Trillo -- who might not even have been the batter had the Phillies not gained that out back in the seventh.)

1981, Game 2: The Yankees' Bobby Brown ran for Lou Piniella at first base with one out in the eighth inning. Graig Nettles dropped a single to center, with Brown stopping at second. Bob Watson singled to left, scoring Brown and moving Nettles to second. On a pickoff attempt, the Dodgers' Dave Stewart threw the ball into center field, advancing both runners a base. Rick Cerone was intentionally walked. Willie Randolph hit a sacrifice fly to deep right, scoring Nettles, before Goose Gossage fanned to end the inning. Conclusion: Even if Piniella had stopped at third on Watson's single, he would have scored on the ensuing throwing error.

1981, Game 6: The Yankees' Aurelio Rodriguez ran for Graig Nettles at first base with one out in the sixth inning. Rick Cerone and Larry Milbourne both walked, pushing Rodriguez to third. Lou Piniella singled to center, scoring Rodriguez. Two outfield line-outs followed. Conclusion: Nettles would have scored from third on Piniella's single.

1982, Game 7: The Cardinals' Mike Ramsey ran for Gene Tenace at first base with one out in the sixth inning (Ozzie Smith was on third base, Lonnie Smith on second). Keith Hernandez singled to right center, scoring both Smiths and sending Ramsey to third. George Hendrick singled to right, scoring Ramsey, with Hernandez stopping at second. Darrell Porter grounded to second, forcing Hendrick, while Porter reached first and Hernandez advanced to third. Steve Braun grounded out to end the inning. Conclusion: Even if he had stopped at second on Hernandez's single, and at third on Hendrick's, Tenace would have scored on the force-out.

1983, Game 4: The Phillies Bob Dernier ran for Bo Diaz at first base with one out in the ninth inning. Ivan DeJesus then grounded to third, with Dernier advancing to second; Dernier subsequently scored on Ozzie Virgil's single to center before the final out. Conclusion: It's reasonable to believe Diaz would have either been retired at second on the grounder, or held at third on the single, so credit the pinch-runner.

(Incidentally, another potential advantage of using a faster runner is to stay out of a double play, with the extra out and/or baserunner enabling the team to score a run they wouldn't have otherwise. That may have been the case here, but I don't see it as a factor in any of the other 27 run-scoring innings.)

1985, Game 6: The Royals' Onix Concepcion ran for Steve Balboni at first base with none out in the ninth inning (Jorge Orta was at second). Jim Sundberg attempted to sacrifice, but Orta was forced out at third, while Sundberg reached and Concepcion advanced to second. Both runners moved up on a passed ball by Cardinals' catcher Darrell Porter. Hal McRae was intentionally walked to load the bases. Dane Iorg singled to right, scoring both Concepcion and Sundberg with the winning runs. Conclusion: Balboni would have scored just as Concepcion did.

1986, Game 7: The Mets' Wally Backman ran for Tim Teufel at third base with one out in the sixth inning (Keith Hernandez was at first). Gary Carter reached when Red Sox' right fielder Dwight Evans attempted a diving catch on his blooper; Backman scored, but Hernandez was forced out at second. Darryl Strawberry lined out to end the inning. Conclusion: Teufel would have scored just as Backman did.

(By the way, Anthony points out that, after Chili Davis was replaced by a pinch-runner in the seventh inning of Game Seven of the 1991 World Series, his spot came up in the batting order again in the ninth – and Gene Larkin came through with the Series-winning hit!)

1995, Game 3: The Indians' Alvaro Espinoza ran for Carlos Baerga at second base with none out in the bottom of the 11th inning. Albert Belle was intentionally walked. Eddie Murray then singled to center, scoring Espinoza with the winning run. *This is the one situation where I have opted to use potential runs rather than actual runs*, because we have no way of knowing what would have happened after Murray's game-ending hit. If we assume Baerga would have stopped at third on the hit, the Indians would have had the bases loaded with none out – giving them an 86% chance of winning the game later in that inning, based on Palmer's run expectancy tables. Since Espinoza increased that to 100%, I am crediting him with .14 runs.

1997, Game 5: The Marlins' Alex Arias ran for Bobby Bonilla at second base with one out in the ninth inning. Arias moved to third on a single to right by Darren Daulton. Moises Alou then singled to center, scoring Arias. Conclusion: Bonilla would have advanced one base on each of the two subsequent singles, just as Arias did.

2000, Game 3: The Mets' Joe McEwing ran for Benny Agbayani at second base with one out in the eighth inning. McEwing advanced to third on an infield single to second by Jay Payton. McEwing then scored standing up on a Bubba Trammell sacrifice fly to medium center field (the throw went to second base), before Kurt Abbott struck out to end the inning. Conclusion: After seeing the video, and discussing with Anthony, we agree that Agbayani would have scored just as McEwing did.

2001, Game 4: The Diamondbacks' Midre Cummings ran for Erubiel Durazo at third base with one out in the eighth inning of a scoreless game. Matt Williams grounded to shortstop Derek Jeter, who attempted to throw out Cummings at home plate. Posada dropped the ball on a bang-bang play, and Cummings was safe, with the batter reaching on the fielder's choice; no error was charged. Steve Finley and Reggie Sanders followed with infield outs. Conclusion: Credit Cummings with the run.

2001, Game 7: The Diamondbacks' Midre Cummings ran for Damian Miller at second base with one out in the ninth inning (Jay Bell was at first). Tony Womack then scored Cummings and advanced Bell to third with a double down the right field line. Craig Counsell was hit by a pitch, loading the bases, and Luis Gonzalez ended the game and Series with a bloop single over the drawn-in infield, scoring Bell. Conclusion: Miller would have scored from second on the double, just as Cummings did.

It is worth noting that there was another pinch-runner earlier in this inning and, though he didn't score, he may have affected the sequence of events. David Delucci pinch-ran for Mark Grace at first base with none out. Miller bunted the ball to pitcher Mariano Rivera, who tried for the force at second base, but was charged with a throwing error and both runners were safe. One could argue that Delucci's speed may have forced the error. Delucci then was forced at third on a sacrifice bunt attempt by Bell.

2003, Game 4: David Delucci, now with the Yankees, ran for Jorge Posada at first base with two outs in the ninth inning (Bernie Williams was at third). Ruben Sierra then tripled to right field, scoring both runners (Sierra, 38, was once a fast runner, but had had only nine triples over the previous ten seasons). Aaron Boone ended the inning on a ground-out. Conclusion: Posada would have scored on Sierra's triple, just as Delucci did. (Anthony disagrees, thinking Posada might have stopped at third, making the hit only a double. I say, if Sierra could make it from home to third, Posada could have scored from first.)

2004, Game 1: The Cardinals' Jason Marquis ran for Mike Matheny at first base with one out in the eighth inning. Roger Cedeno singled to left, moving Marquis to second. Edgar Renteria singled to left, where Manny Ramirez committed an error, allowing Marquis to score. Ramirez then muffed a fly ball hit by Larry Walker, allowing Cedeno to score, Renteria to reach third, and Walker to reach second. After an intentional walk to Albert Pujols, an infield pop and strikeout ended the inning. Conclusion: even if Matheny didn't score on Manny's first error, he would have scored on the second.

2008, Game 5: The Phillies' Eric Bruntlett ran for Pat Burrell at second base with none out in the seventh. Bruntlett advanced to third on a sharp ground-out to second baseman Akinori Iwamura (who didn't even look to third) by Shane Victorino, then scored on Pedro Feliz's single to center, which landed softly on the grass and lost momentum. Carlos Ruiz and J. C. Romero then each hit into fielder's choice plays at second base to end the inning, with Iwamura making a diving stop on Ruiz's ball. Conclusion: After discussing with Anthony, who watched the video, we agree that Burrell would have scored one way or another, just as Bruntlett did.

2009, Game 2: The Yankees' Brett Gardner ran for Jerry Hairston at first base with none out in the seventh inning. Melky Cabrera singled to right on a hit-and-run, advancing Gardner to third. Jorge Posada singled sharply to center, scoring Gardner, and moving Cabrera to second. After Derek Jeter struck out, Johnny Damon lined to the first baseman, who doubled up Posada after he went to second, thinking the ball was short-hopped. Conclusion: After seeing the video, and discussing with Anthony, we agree that it is reasonable to think Hairston would have stopped at second on Cabrera's single, and at third on Posada's, so I am crediting Gardner with the run.

2011, Game 3: The Cardinals' Daniel Descalso ran for David Freese at first base with one out in the eighth inning. Yadier Molina doubled to center, scoring Descalso. Two infield ground-outs (to first base and shortstop) followed. Conclusion: Credit Descalso with the run, assuming Freese would have stopped at third on the double and held there on the first ground-out.

2013, Game 2: The Cardinals' Pete Kozma ran for David Freese at second base with one out in the seventh inning (Jon Jay was at first). Kozma and Jay then executed a double-steal. Daniel Descalso walked on a 3-2 pitch, loading the bases. Matt Carpenter then hit a sacrifice fly to left, followed by two Boston errors before the play was over, scoring both Kozma and Jay, and advancing Descalso to third. Carlos Beltran then singled in Descalso before the third out. Conclusion: Freese, even without the steal, would have reached third on the walk, and scored as the two runners behind him did. (Anthony came to a different conclusion in his 2016 article.)

2014, Game 2: The Royals' Terrance Gore ran for Billy Butler at first base with none out in the sixth inning (Eric Hosmer was on second). After a fly out, Hunter Strickland uncorked a wild pitch, advancing both runners. Salvador Perez then doubled to score them both. Omar Infante followed with a home run before the final two outs. Conclusion: Butler would have advanced to second on the wild pitch just as Gore did, since Hosmer made it to third (but even if he didn't, and stopped at third on the double, he would have scored on the homer).

2015, Game 5: The Royals' Jarrod Dyson ran for Salvador Perez at first base with one out in the 12th inning. Dyson stole second. Alex Gordon then grounded to first base, advancing Dyson to third. Christian Colon singled to left, scoring Dyson. Paolo Orlando grounded to second, where Daniel Murphy unsuccessfully tried to force out Colon; Murphy was charged with an error and both runners were safe. Alcides Escobar doubled to left, scoring Colon and moving Orlando to third. Ben Zobrist was intentionally walked, and Lorenzo Cain cleared the bases with a double, before the final two outs were made. Conclusion: Perez may have been retired at second on Gordon's grounder, but we can't assume a double play, and Gordon would have reached first and eventually scored on the subsequent events, just as the four batters after him did; so the Royals still would have scored five runs, though one of them may have been by Gordon rather than Perez.

2016, Game 3: The Indians' Michael Martinez ran for Roberto Perez at first base with none out in the seventh inning. Tyler Naquin's sacrifice bunt advanced Martinez to second. Martinez moved to third on a wild pitch by Cubs' pitcher Carl Edwards. Rajai Davis walked, putting runners at first and third with one out. (Martinez was nearly picked off by the catcher after ball four, but the umpire called him safe, and the Cubs' challenge failed.) Coco Crisp singled to right, scoring Martinez, but Davis was thrown out trying to advance to third. A ground-out ended the inning. Conclusion: After seeing the video, one could definitely argue that Perez would not have advanced on the wild pitch, and would then have stopped at third on Crisp's single. But if so, Davis would have had to stop at second, and the Indians would have had the bases loaded and one out, projecting to 1.546 potential runs, instead of just a runner on first and two out, projecting to a mere 1.209 runs (including Martinez's run). So, I can't credit the pinch-running strategy with any positive effect here.

2016, Game 7: The Cubs' Albert Almora ran for Kyle Schwarber at first base with none out in the tenth inning. Kris Bryant flied out deep to center, and Almora tagged and reached second after the catch. Anthony Rizzo was intentionally walked. Ben Zobrist doubled to left, scoring Almora, and moving Rizzo to third. Addison Russell was intentionally walked. Miguel Montero singled to left, advancing everybody one base, before the final two outs. Conclusion: though we can assume Schwarber wouldn't have advanced to second on the fly-out, he would have on Rizzo's walk, which we can't erase, despite its being intentional. From there, Schwarber would have scored on Zobrist's double, just as Almora did.

It's likely I have overlooked other factors, or that seeing all the plays on film rather than on paper might have resulted in a different conclusion somewhere. But the sum of my conclusions is that, of those 27 pinch-runners who scored, there were only four instances in which I believe that the player he replaced would *not* have scored: the 1983 tally by Bob Dernier, the 2001 run by Cummings in Game Four, the 2009 score by Gardner, and the 2011 run by Descalso (plus the .14 of a run by Espinoza in 1995).

Yet, despite Dernier's run, the Phillies lost, 5-4. Despite Cummings's run, the D'backs lost, 4-3. The Yankees won the 2009 game, 3-1, so Gardner's run was not the difference. And the Cardinals already had a 14-7 lead before Descalso's run (and won 16-7); we're not talking strategy here. So, out of these 136 substitutions over 46 years and 264 games of World Series play, the only one which *might* have made a difference in the game's outcome was Espinoza's in 1995.

On the negative side of the ledger, ten of the 136 pinch-runners were thrown out on the bases, costing both a baserunner and an out: seven caught stealing, two picked off, and one thrown out trying to score on a foul pop (there were ten successful steals, only two, listed above, leading to a run).

It's impossible to prove that any of these negative outcomes cost runs or games, but we can estimate the damage. I used Pete Palmer's run and win probability tables to analyze the ten baserunning blunders, below, with the "expected win %" representing the team's win probability had the runner stayed put vs. its probability after the out, and likewise with the number of expected runs:

World Series pinch runners thrown out on the bases, 1970-2016

Year	g	Inn	Pinch runner	Outcome	Expected Win %	Expected Runs	Cost in Wins	Cost in Runs
1972	1	9	Allen Lewis, OAK	CS	.849 → .823	.478 → .095	.026	.383
1972	2	6	Allen Lewis, OAK	CS	.779 → .763	.209 → .000	.016	.209
1972	5	9	John Odom, OAK	Retired	.201 → .000	.494 → .000	.201	.494
1974	2	9	H. Washington, OAK	Pick-off	.160 → .034	.478 → .095	.126	.383
1979	2	9	Matt Alexander, PIT	CS	.575 → .447	.783 → .249	.128	.534
1984	5	8	Luis Salazar, SD	CS	.180 → .125	.209 → .000	.055	.209
1991	6	11	Keith Mitchell, ATL	CS	.575 → .447	.783 → .249	.128	.534
1992	3	9	Brian Hunter, ATL	CS	.501 → .403	.478 → .095	.098	.383
1999	3	9	Otis Nixon, ATL	CS	.575 → .447	.783 → .249	.128	.534
2013	4	9	Kolten Wong, SL	PO	.040 → .000	.209 → .000	.040	.209

So, these ten events cost their teams a total of .946 wins and 3.87 runs – not insignificant, but less than I would have thought.

Furthermore, the replaced player's spot came back up in the batting order on 51 occasions; the substitutes managed only a .240-.255-.300 batting line (12-for-50 with three doubles and one walk) in those situations. The cost of this is harder to quantify but, for those 51 events, I took the weighted average of the players who were replaced, based on their performances in those particular seasons (not just the Series, as I did last time). It came to a .260 batting average, .350 on-base percentage, and .434 slugging percentage. That's obviously a good deal better than the marks of the replacement players, but how to translate that into runs and/or wins? Using Bill James's basic runs created formula, it would be roughly 6.79 runs vs. 3.80, or a loss of about 2.99 runs. At ten runs per win, that's .3 wins. It's possible that somewhere along the line, a team lost a game or even a series due to such a substitution.

So, all in all (by my estimations), pinch-runners were responsible for 4.14 extra runs**,** while costing their teams about 6.86 runs due to reckless baserunning and weakened batting orders, a net loss of 2.72 runs. As Anthony suggests, the results have been better in the more recent years of our joint study, but still show about as many runs cost as produced.

I would not suggest that it never makes sense to use a pinch-runner. But I think this study offers some evidence that the strategy of using pinch-runners, overall, has negligible value at best – much ado about nothing – and may actually decrease a team's chances of scoring and winning.

Bill Deane, billdeane14@gmail.com ♦

Intentional Walks Revisited

Pete Palmer

Early research on the value of an intentional walk came from estimates of average run values. Now, with the availability of Retrosheet data, it is possible to calculate specific situational values based on game situation and the skill and handedness of the batters involved. Pete Palmer compiled that data and shares many new findings.

When I did my Linear Weights work in the 1960s, I assumed that each batting event was equally likely to occur in any base-out situation. From that, I developed a win probability model based on a computer simulation which gave the distribution of runs expected to be scored from each situation. At the time, I did not separate walks and intentional walks, since there was very limited data. Intentional walks had been counted only since 1955.

But now, we have a full record, back to 1946, of what happened in every situation. That's from play-by-play files from Retrosheet, available thanks to Bill James, Gary Gillette, Dave Smith and many helpers.

From Retrosheet data, I created a win probability table for each league each year. I then compared the change in run probability and win probability for each plate appearance during that period. I had previously determined that an extra ten runs during the season produces about one more win. The actual value depends on the level of run scoring for the league, but that value is almost always between 9 and 11 and usually pretty close to ten. Thus increasing the expected run probability by a given amount should result in the win probability going up by one tenth as much.

I looked at all the games of the past 70 years, and for the most part, this worked fairly well and the values of the various events agreed with the linear weight values I had developed in the sixties.

Table 1 – Linear Weight values, simulated ("old") vs. play-by-play ("new")

	old LW run value	new LW run value	new LW win value	runs / win
Single	.47	.453	.044	9.7
Double	.78	.752	.071	9.4
Triple	1.02	1.038	.100	9.6
Homer	1.40	1.413	.138	9.8
Walk	.33	.298	.028	9.3
Int Wk	--	.157	.0075	4.8
Out	-.25	-.241	-.247	9.8

The table suggests that the actual run per win value was more like 9.7 than 10.0. Of course the most interesting values are those for intentional walks, which I included with ordinary walks initially. Not only is the potential run value about half of a normal walk, but the win value is down by half again.

The reason for this is that intentional walks usually occur in base-out situations where the value in terms of runs is lower, and also in inning and score situations where the value in terms of runs is lower still. This is because pitchers have some discretion when issuing walks. Table 2 shows all walks from 2010 to 2015. (Note that most of the high values for IBB come from very small samples. Also, the abbreviation "UBB" denotes unintentional walks, here and in later tables.)

Table 2 – Run value of walks, by situation

Outs	Bases	uBB/PA	IBB/PA	Runs/uBB	Runs/IBB	Wins/ 1000 uBB	Wins/ 1000 IBB
0	empty	.0679	.00000	0.37	0.00	36.8	0.0
	1	.0562	.00000	0.57	0.00	52.3	0.0
	2	.0823	.00439	0.32	0.32	23.9	6.1
	12	.0571	.00000	0.80	0.00	67.3	0.0
	3	.0896	.00496	0.38	0.41	27.7	7.2
	13	.0592	.00688	0.46	0.46	30.7	3.4
	23	.0853	.03619	0.25	0.23	13.8	2.6
	123	.0541	.00000	1.00	0.00	74.4	0.0
1	empty	.0707	.00001	0.25	0.25	25.0	58.0
	1	.0623	.00001	0.36	0.38	34.6	79.0
	2	.1021	.02387	0.22	0.21	17.6	10.2
	12	.0707	.00000	0.64	0.00	56.7	0.0
	3	.0975	.03215	0.17	0.17	12.7	2.2
	13	.0602	.00606	0.40	0.39	30.8	13.7
	23	.0821	.12274	0.16	0.14	9.7	2.3
	full	.0562	.00000	1.00	0.00	80.8	0.0
2	empty	.0798	.00006	0.12	0.12	12.5	26.4
	1	.0704	.00013	0.19	0.20	18.7	24.1
	2	.1046	.05077	0.11	0.10	9.0	6.8
	12	.0797	.00088	0.31	0.30	26.5	44.1
	3	.1123	.03778	0.12	0.12	10.6	8.3
	13	.0833	.00390	0.26	0.27	20.8	23.0
	23	.1065	.08086	0.19	0.18	15.1	13.6
	full	.0726	.00000	1.00	0.00	91.7	0.0

What you can see here is that there is an inverse correlation between the run value of a walk and its frequency. The highest value walk comes with the bases loaded, where the frequency of occurrence is lowest. The highest frequencies for non-intentional walks line up with situations which most intentional walks occur, which suggests a good many of them are semi-intentional ones.

Since the bases empty rate for walking is around seven percent, you could say that a ten percent figure in IBB situations actually includes three percent semi-intentional walks, which is fairly close to the number of walks scored as intentional. This muddies the water when treating walks and intentional walks differently.

The only way to handle this is to consider each walk in context, whether it was technically intentional or not. Since we have now play-by-play data, we can estimate this.

Looking at all 951 intentional walks from 2015, there were 55 where the batting team's win probability actually went down. These were all in late innings, usually with the home team batting. An intentional walk always increases the number of potential runs, but does not always increase the probability of getting at least one run. The actual numbers vary with league and year. For example in the NL for 2015, the probability of scoring no runs went from 37.6 to 40.2 percent for a walk with a runner on second and none out, even though the total run potential went from 1.08 to 1.37. With a runner on third with one out, the zero run probability went from 34.7 to 40.3 percent.

If walks had actually occurred equally in all base-out situations, my value of .33 runs per walk would have been reasonable. However, as shown in the table above, this is not the case. The proper value for a non-intentional walk should be about .31, and for the intentional walk about .08. Since IBB are about ten percent of total walks, the combined value works out to about .29.

Extrapolating career totals

Intentional walks were first kept officially in 1955, but, thanks to Retrosheet, we now have reasonably complete data back to 1946. We have play-by-plays for every game, but it is possible that some intentional walks were not noted. We also have about 75% of the total walks covered for 1921-40 and over 50% for 1941-45. We do have complete data for the World Series back to 1903. Intentional walks there were usually more frequent there than in the regular season. The data in Table 3 indicates that the Retrosheet data is pretty good.

Table 3 – Intentional Walks in World Series (complete data) and regular season Retrosheet (incomplete for some eras)

	World Series			Regular Season			
	BB	IBB	IBB/BB %	BB	IBB	IBB/BB %	Available data %
1903-20	482	20	4.2				
1921-30	333	15	4.5	56146	2291	4.1	75
1931-40	323	30	9.3	57820	3609	6.2	72
1941-50	369	52	14.1	69963	5521	7.9	53/100
1951-60	441	45	10.2	86688	6954	8.0	100
1961-70	327	41	12.5	105390	11133	10.6	100
1971-80	405	53	13.1	130232	13415	10.3	100
1981-90	364	48	13.2	131826	12974	9.8	100
1991-00	415	51	12.3	152481	12029	7.9	100
2000-15	544	63	13.4	232491	18427	7.9	100

We can extrapolate from the available percentages to estimate lifetime leaders in intentional walks:

Table 4 – Lifetime IBB leaders, with missing data estimated

	BB logged	IBB logged	% IBB logged	estimated IBB
Barry Bonds	2558	688	all	**688**
Stan Musial	1490	281	.932	**302**
Albert Pujols	1165	296	all	**296**
Henry Aaron	1403	291	all	**291**
Willie McCovey	1346	260	all	**260**
Ted Williams	1545	224	.764	**254**
Vladimir Guerrero	737	250	all	**250**
Ken Griffey Jr.	1312	246	all	**246**
Babe Ruth	1644	185	.797	**232**
George Brett	1096	228	all	**228**
Willie Stargell	937	225	all	**225**
Eddie Murray	1333	222	all	**222**
Frank Robinson	1418	218	all	**218**
Willie Mays	1470	217	all	**217**
Manny Ramirez	1329	216	all	**216**
Miguel Cabrera	936	205	all	**205**
Tony Gwynn	790	203	all	**203**
Mike Schmidt	1507	201	all	**201**
Ernie Banks	763	200	all	**200**
David Ortiz	1239	194	all	**194**
Rusty Staub	1255	193	all	**193**
Carl Yastrzemski	1845	190	all	**190**
Chili Davis	1194	188	all	**188**
Ted Simmons	855	188	all	**188**
Harold Baines	1062	187	all	**187**
Carlos Delgado	1109	186	all	**186**
Todd Helton	1335	185	all	**185**
Billy Williams	1045	182	all	**182**
Wade Boggs	1412	180	all	**180**

In addition to these, there were were 25 other batters with 150 or more IBB to their credit.

There were many fewer IBBs in earlier years. Here is a list of players with 100 or more (estimated) intentional walks who played mostly before 1946. I included Babe Ruth, who was the only player from the earlier period in the previous table.

Table 5 – Lifetime IBB leaders, pre-1946 players, with missing data estimated

	BB logged	IBB logged	% BB logged	estimated IBB
Babe Ruth	1644	185	.797	232
Ernie Lombardi	386	141	.898	158
Bill Nicholson	536	92	.670	153
Jimmie Foxx	1147	102	.790	129
Al Lopez	431	97	.776	126
Mel Ott	1106	80	.648	124
Lou Gehrig	1252	102	.830	123
Johnny Mize	630	80	.736	119
Joe DiMaggio	767	108	.971	112
Gabby Hartnett	555	88	.789	111
Joe Medwick	313	72	.716	107
Dixie Walker	731	96	.895	106
Bill Dickey	577	88	.851	104

Barry Bonds is in a class by himself when it comes to intentional walks. His career total is more than double that of the runner-up. He received 120 free passes in 2004 and also holds second and third spot on the season list. In the five year period from 2000 to 2004, coming up with one out and a runner on second (or second and third), he was walked 95 times in 159 appearances, 74 of the 95 being intentional. With two out, it was 114 out of 154 PA (101 intentional). The normal rate for those situations is less than 10 percent.

Ruth's walks can be divided into two periods. Before 1925, about 22 percent of his walks were intentional. After that it was 4 percent. I suspect Lou Gehrig had something to do with that. From 1920 to 1924, Ruth was walked 38 percent of the time with second base or second-and-third occupied with one out -- and 44 percent in the same situations but two outs.

Bonds and Ruth have high values of wins per intentional walk. This is because they were often walked in more crucial situations than normal players. Bonds' run value for his IBBs was .172, about average, but his win value was .0130, where most players drop to half or less. Ruth was .267 runs and .0191 wins.

Ernie Lombardi was a powerful hitter who did not walk much. It is a good measure of respect for him that he was walked intentionally more often than any player up through his era besides Ruth.

Lopez was an example of the misguided strategy to walk the eighth place hitter to get to the pitcher. Doing this could gain a little initially, but it also eliminates the possibility of the pitcher leading off the next inning, so the overall effect is negative. Of the top 85 players with known intentional walks before 1945, 23 were catchers. Many of them were weak hitters who usually batted eighth. And of course, catchers do not play as many games as those at other positions because of the rigors of the job.

IBB by batting order position

Looking at data back to 1921, walking the 8th place hitter has been a staple of strategy forever. The 8th place hitter is walked more frequently than anyone else, often by a wide margin. Table 6, below, shows the breakdown by batting order position. Pitchers are excluded.

Table 6 – IBB by batting slot, pitchers excluded

batting slot	1921-40	1941-72	1973-00 NL	2001-15 NL	1973-00 AL	2001-15 AL
1	0.12	0.32	0.50	0.29	0.39	0.33
2	0.10	0.18	0.22	0.12	0.27	0.18
3	0.37	0.80	0.99	1.21	0.95	0.93
4	0.66	1.26	1.46	1.33	1.06	1.12
5	0.53	0.97	1.10	0.73	0.93	0.68
6	0.43	0.91	1.00	0.65	0.77	0.55
7	0.40	0.96	1.02	0.61	0.73	0.51
8	1.04	1.89	2.16	1.85	0.54	0.46
9	0.37	0.67	0.79	0.46	0.15	0.09

I looked at instances where the eighth hitter was walked (skipping the AL in the DH era). Three main cases covered 5422 of the 6565 instances from 1994 to 2015. I also included second-and-third with one out, which had a high use percentage, but a small total sample. Thus the data is not as reliable. However, walking the bases loaded with only one out would contribute to the runs being higher with the intentional walk.

The most common IBB situation was runner on second and two out. Here walking the eighth man reduced the number of runs scored in that inning by .033 runs, but the following inning was increased by .113 runs, so there was a net gain for the batting team of .080 runs each time. The other cases were similar. When there were runners on second and third with two out, an intentional walk was issued over half the time.

Even though there is a lot of data here, there is still a significant error factor. A very useful number to know if the expected variation due to chance in samples of runs. If every player either struck out or hit a home run, then the standard deviation would be the square root of the number of runs. But baseball doesn't work like that. It is possible to score more than one run at a time and also driving in a run can often lead to a situation where more runs are likely. It turns out that the actual sigma is the square root of twice the number of runs involved.[1] For example, with the runner on 2nd case, with no intentional walk, there were 3214 runs scored in 12834 cases. The square root of two times 3214 is 80. 80 over 12834 is .006. This comes into play when measuring differences, where sometimes the difference is less than sigma.

The following tables show values for the four main situations:

[1] This finding stems partly from an article by Dallas Adams, in the very first issue of Bill James' Baseball Analyst, back in 1982. (The Analyst ran for 8 years and had many fine articles.) Adams showed the distribution of runs scored in games as a function of the average number of runs scored. This was before there was a lot of computerized data available. There were 232 team-seasons from 1967 through 1976, divided into 11 groups in intervals of one-quarter runs per game. I analyzed his data and noticed the relationship between average runs and standard deviation, which I now use here.

Table 7 – Run values

	this inning			next inning				sample size		
situation	no IBB	IBB	diff	no IBB	IBB	diff	net	no IBB	IBB	pct
1 out, 23	1.169	1.258	0.088	0.559	0.610	0.051	0.140	2872	683	23.8
2 out, 2	0.250	0.218	-0.033	0.517	0.630	0.113	0.080	12834	3011	23.5
2 out, 3	0.295	0.293	-0.002	0.527	0.578	0.051	0.049	5223	1055	20.2
2 out, 23	0.489	0.428	-0.061	0.523	0.576	0.053	0.008	2712	1356	50.0

Table 7b – Standard deviations of run values from table above

	this inning			next inning			
situation	no IBB	IBB	diff	no IBB	IBB	diff	net
1 out, 23	0.029	0.020	0.035	0.061	0.043	0.074	0.082
2 out, 2	0.006	0.009	0.011	0.012	0.021	0.024	0.026
2 out, 3	0.011	0.014	0.018	0.024	0.035	0.042	0.046
2 out, 23	0.019	0.020	0.027	0.025	0.029	0.039	0.047

Adjusting Player Wins

For all-time career runs/wins by batters, my current leaderboard shows Bonds on top at 130 wins better than average. Ruth is second with 129. The rest of the top ten are spread between 83 and 95. Ted Williams would be third at 115 if estimates for his years missed in the military were added.

But those values use a single, standard value for all walks. Now that we have better information on intentional walks, how do we adjust the totals?

Since we can make reasonable guesses on total intentional walks back to 1915, we could divide walks into two groups, with .31 runs for the non-intentional and .08 for the intentional, instead of the generic .33 value. With that adjustment, Bonds' above average rating would drop from +130 to +109, by far the biggest decline. Babe Ruth would drop nine wins, from 129 to 120.

However, this is a bit harsh, because both men received extensive intentional walks in less advantageous situations, which increased their value beyond the average IBB. Based on change in win probability, Bonds would be .13 runs per intentional walk and Ruth .19, rather than .08 for each. Using those figures, Bonds would drop only to 113, and Ruth to 122. I believe it should be possible to adjust the linear weight player ratings for intentional walks player by player based on individual play-by-play data.

Table 8 shows all players with at least 150 intentional walks since 1946. You can see that most player walk figures are similar and both runs and wins are close. Most players intentional walk runs are lower, maybe a bit over half, and wins are lower again. Bonds' win value for IBB is quite high.

Table 8 – Career leaders, Linear Weights runs from BB, adjusted for IBB situational run expectancy

	PA	uBB	wins / 1000 UBB	runs / 100 UBB	iBB	wins / 1000 IBB	runs / 100 IBB	total BB	wins / 1000 BB	runs / 100 BB
Bonds	12912	1870	28.6	30.2	688	13.0	17.2	2558	24.4	26.7
Pujols	10189	869	24.9	27.6	296	9.6	16.2	1165	21.0	24.7
Aaron	14375	1112	26.6	27.6	291	10.3	16.7	1403	23.2	25.3
Musial	11013	1118	27.3	29.3	261	8.6	16.3	1379	23.8	26.8
McCovey	10084	1086	29.4	28.8	260	9.6	15.1	1346	25.5	26.1
Guerrero	9361	487	27.4	29.3	250	11.1	17.1	737	21.9	25.2
Griffey	11723	1066	26.1	28.8	246	10.3	18.5	1312	23.2	26.9
Brett	12309	868	24.1	26.3	228	8.9	16.7	1096	21.0	24.3
Stargell	9331	712	26.8	27.8	225	8.8	16.1	937	22.4	25.0
Murray	13153	1111	28.7	29.7	222	7.7	16.9	1333	25.2	27.6
F.Robinson	12195	1200	26.8	27.2	218	8.6	16.7	1418	24.0	25.6
Mays	12838	1253	27.1	28.0	217	8.6	15.5	1470	24.3	26.1
M.Ramirez	10152	1113	28.2	32.7	216	10.4	18.8	1329	25.3	30.5
M.Cabrera	8584	731	27.1	29.7	205	10.8	17.0	936	23.5	26.9
Gwynn	10771	587	27.3	27.8	203	7.1	14.8	790	22.1	24.5
Schmidt	10647	1306	25.9	26.7	201	8.2	15.8	1507	23.5	25.2
Banks	10650	563	29.2	28.3	200	8.6	15.4	763	23.8	24.9
T.Williams	7342	1325	27.3	32.6	200	9.3	16.0	1525	24.9	30.5
Ortiz	9768	1045	27.3	31.4	194	8.6	17.4	1239	24.4	29.2
Staub	11613	1062	26.2	27.9	193	7.6	15.0	1255	23.3	25.9
Yastrzemski	14396	1655	26.4	27.3	190	9.9	17.0	1845	24.7	26.2
C.Davis	10407	1006	27.6	29.5	188	7.3	16.8	1194	24.4	27.5
Simmons	10048	667	27.1	28.0	188	7.8	16.3	855	22.9	25.4
Baines	11478	875	28.6	31.2	187	8.6	17.6	1062	25.1	28.8
Delgado	9011	923	26.1	30.8	186	9.8	17.9	1109	23.3	28.6
Helton	9814	1150	26.3	29.2	185	8.9	16.6	1335	23.9	27.5
B.Williams	10856	863	26.3	25.9	182	9.5	18.3	1045	23.4	24.6
Boggs	11082	1232	27.9	32.5	180	9.4	16.3	1412	25.5	30.4
Suzuki	10341	417	30.4	31.9	179	9.9	17.2	596	24.2	27.4
C.Jones	11013	1335	26.3	29.4	177	8.4	15.8	1512	24.2	27.8
Thome	10687	1574	25.9	30.7	173	11.1	18.6	1747	24.4	29.5
Palmeiro	12465	1181	26.9	30.8	172	10.0	18.0	1353	24.7	29.2
Winfield	12841	1044	29.4	30.5	172	7.9	16.5	1216	26.3	28.5
McGriff	10491	1134	28.7	31.1	171	8.0	14.9	1305	26.0	29.0
Parker	10723	514	26.4	26.4	169	7.3	14.8	683	21.7	23.6
F.Thomas	10530	1499	27.3	31.2	168	12.1	20.3	1667	25.8	30.1
Clemente	10541	454	26.9	26.2	167	7.8	15.3	621	21.8	23.3
Rose	16516	1399	27.5	28.4	167	7.8	14.3	1566	25.4	26.9
R.Jackson	11859	1212	26.3	28.3	164	7.5	17.0	1376	24.1	27.0
P.Fielder	6722	652	27.2	30.2	163	10.0	15.9	815	23.7	27.3
Killebrew	10211	1400	25.3	26.9	161	11.0	17.2	1561	23.8	25.9
Berkman	8070	1041	27.4	29.3	160	7.0	14.5	1201	24.7	27.3
D.Murphy	9508	827	28.2	27.4	159	6.4	14.1	986	24.7	25.3
Olerud	9417	1118	27.1	31.5	157	8.1	16.7	1275	24.8	29.7
Bagwell	9949	1246	25.6	28.3	155	9.3	16.8	1401	23.8	27.0
Cepeda	8984	432	28.0	28.2	155	6.6	14.6	587	22.3	24.6
W.Clark	8653	782	25.8	28.1	155	8.2	15.0	937	22.9	25.9
D.Snider	8454	817	26.2	29.5	154	7.8	16.5	971	23.3	27.4
Sosa	10224	775	27.1	30.1	154	8.7	17.6	929	24.0	28.1
R.Howard	6470	530	25.4	28.0	152	10.5	15.3	682	22.1	25.2
L.Gonzalez	10906	1005	26.0	29.0	150	8.0	16.0	1155	23.7	27.3
McGwire	7933	1167	26.5	30.1	150	13.0	17.9	1317	24.9	28.7
T.Perez	11411	775	26.2	27.8	150	7.0	15.6	925	23.1	25.8

The IBB as a strategy to face a lesser hitter

Next I looked at the strategy of intentional walks. One reason to walk a hitter is that the next hitter might not be as good a batter. From the Retrosheet play-by-play data I took every at-bat from 1946 to 2015 and measured the change in win probability. For each season I added up individual player totals. I divided all players with 400 or more appearances into six groups by season win probability change totals. The average player included in the six groups was about one half a win better than average. There were about 100 players per year in 1946 increasing to about 200 in 2015.

I then took every at-bat by each group and measured the number of runs score from that situation until the end of the inning. This accounted for about seven million appearances out of a total of ten million. Using the square root of twice the runs method, I calculated the sigma for each sample, which was pretty small except for the multiple runner cases with none out. Using the seventy year data drove the sigma down so it was usually less than the difference between the groups. The table below shows the expected number of runs to be scored from each situation based on batter player win average rating for the season and also the difference between each group.

Table 9 – Run Expectation, controlling for base/out and batter ability (batter's Win Probability Added that season, in wins)

outs	bases	WPA <-1	WPA -1-0	WPA 0-1	WPA 1-2	WPA 2-3	WPA >3	SD
0	empty	0.48	0.49	0.51	0.52	0.53	0.55	0.00
	1	0.82	0.86	0.89	0.92	0.94	0.99	0.01
	2	1.07	1.10	1.13	1.15	1.18	1.19	0.02
	12	1.40	1.45	1.47	1.56	1.59	1.68	0.02
	3	1.31	1.33	1.37	1.40	1.39	1.43	0.04
	13	1.65	1.72	1.76	1.79	1.83	1.88	0.03
	23	1.88	1.97	1.99	2.07	1.99	2.09	0.05
	full	2.19	2.31	2.34	2.32	2.43	2.54	0.05
1	empty	0.25	0.26	0.28	0.28	0.30	0.32	0.00
	1	0.47	0.50	0.54	0.56	0.59	0.64	0.01
	2	0.62	0.67	0.70	0.72	0.75	0.80	0.01
	12	0.83	0.89	0.94	0.99	1.03	1.10	0.01
	3	0.89	0.92	0.96	0.98	1.01	1.05	0.02
	13	1.10	1.16	1.18	1.22	1.27	1.32	0.02
	23	1.30	1.36	1.45	1.43	1.46	1.56	0.03
	full	1.43	1.55	1.59	1.66	1.73	1.80	0.03
2	empty	0.09	0.10	0.11	0.11	0.12	0.14	0.00
	1	0.19	0.22	0.23	0.25	0.27	0.30	0.00
	2	0.29	0.32	0.34	0.37	0.38	0.41	0.01
	12	0.38	0.42	0.46	0.50	0.53	0.59	0.01
	3	0.34	0.37	0.39	0.41	0.42	0.46	0.01
	13	0.46	0.49	0.52	0.54	0.59	0.63	0.01
	23	0.51	0.60	0.63	0.65	0.70	0.74	0.02
	full	0.64	0.74	0.81	0.86	0.91	0.99	0.02

	<-1	-1-0	0-1	1-2	2-3	>3
IBB per 100 PA	0.56	0.64	0.70	0.83	0.93	1.40

With two outs, runner on second base and a top-rated batter up, the scoring potential is .41 runs. If you walked that batter to face a 6th class batter (WPA < -1), the scoring potential goes down to .38. If the current batter was at the high end of the top class, the difference could be even larger.

The increase in scoring potential for two class-one batters (WPA>3) with a runner on second and two out is .18 runs (41 to .59), but if the next hitter is a class two (WPA between 2 and 3), the potential is only .53, which knocks off a third of the increase. That is a typical reduction if next batter is one class below the player being walked. With runners on second and third (.74 runs), you would break even dropping down just four classes.

The top class hitters are walked intentionally about twice as much as average (1.40 percent compared to .70 percent), but the lower classes get quite a few, probably due to the practice of passing the eighth batter.

Handedness

Another reason to walk a batter would be to get a favorable lefty-righty matchup with the next batter. I believe this is overdone because the actual differences are small. The average lefty batter hitters about 20 points higher versus a right hand pitcher, one hit in fifty times up. Righties have a smaller difference, probably because they face same-side pitchers more often. OPS (on base plus slugging) is 85 points higher for lefties in favorable situations, 55 for righties. I did a similar study calculating the runs scored in the rest of the inning based on the handedness of the batter and pitcher. Sigmas for lefties and switch batters are higher because the data comes from a smaller sample. For the most part, a difference of about .03 runs might be expected based on the handedness matchup.

In the table below, "RL" means a righthanded batter facing a lefthanded pitcher:

Table 10 – Run Expectation, controlling for batter/pitcher handedness

outs	bases	RR	RL	diff	LR	LL	diff	BR	BL	diff
0	empty	0.48	0.48	+.00	0.50	0.48	-.02	0.52	0.51	+.01
	1	0.84	0.84	+.00	0.90	0.86	-.04	0.91	0.87	+.04
	2	1.09	1.08	-.01	1.13	1.11	+.02	1.15	1.13	+.02
	12	1.45	1.47	+.02	1.53	1.49	-.04	1.53	1.47	+.05
	3	1.32	1.32	+.00	1.35	1.36	+.01	1.41	1.41	+.00
	13	1.72	1.70	-.02	1.80	1.74	-.06	1.78	1.78	+.00
	23	1.95	1.94	-.01	2.03	1.99	-.04	1.98	1.98	-.01
	full	2.28	2.28	+.00	2.34	2.32	-.02	2.28	2.30	-.02
1	empty	0.25	0.26	+.01	0.27	0.26	-.01	0.27	0.27	-.00
	1	0.50	0.50	+.00	0.55	0.52	-.03	0.54	0.51	+.02
	2	0.66	0.68	+.02	0.71	0.67	-.04	0.70	0.71	-.01
	12	0.88	0.92	+.04	0.96	0.93	-.03	0.91	0.89	+.01
	3	0.91	0.93	+.02	0.99	0.92	-.07	0.96	0.93	+.03
	13	1.13	1.14	+.01	1.21	1.19	-.02	1.19	1.17	+.02
	23	1.34	1.38	+.04	1.44	1.36	-.08	1.42	1.39	+.03
	full	1.48	1.55	+.07	1.62	1.61	-.01	1.61	1.53	+.07
2	empty	0.10	0.10	+.00	0.11	0.10	-.01	0.10	0.10	+.00
	1	0.21	0.23	+.02	0.24	0.21	-.03	0.22	0.21	+.01
	2	0.32	0.34	+.02	0.35	0.31	-.04	0.32	0.32	-.00
	12	0.43	0.45	+.02	0.47	0.42	-.05	0.43	0.46	-.03
	3	0.37	0.38	+.01	0.39	0.37	-.02	0.38	0.36	+.02
	13	0.49	0.50	+.01	0.52	0.49	-.03	0.51	0.48	+.03
	23	0.58	0.62	+.04	0.61	0.56	-.05	0.57	0.62	-.04
	full	0.73	0.77	+.04	0.81	0.73	-.08	0.78	0.75	+.03

In the runner-on-second-and-two-out case, the overall average number of runs is around .33. Walking the batter increases it to .44. With a lefty pitcher and righty batter, the run potential is .34, but if you walk the righty to face a lefty, the potential only goes up to .42, which knocks about one quarter off the increase.

Inning and score

Probably the biggest factor is the inning and score situation. In the late innings when the score is close, the run represented by the walker is worth a lot less. The win probability table can show this. The data below is from the American League for 2015.

Table 11 – Win Probabilities based on inning, score, base/out situation

Inning	batting team score	0 out			1 out			2 out		
		runner on 2nd	1st and 2nd	diff	runner on 2nd	1st and 2nd	diff	runner on 2nd	1st and 2nd	diff
bot 9	0	.806	.812	.006	.695	.698	.003	.605	.605	.000
bot 9	-1	.434	.516	.082	.275	.321	.056	.140	.162	.022
top 9	0	.671	.701	.029	.560	.576	.016	.469	.476	.007
bot 8	0	.739	.762	.023	.651	.664	.013	.579	.585	.006

The two out, last of the ninth (or extra innings) situation is a breakeven case for walking, but other situations can reduce the increase in scoring potential from the normal case.

The table below shows potential runs before and after the walk, as well as the percent of the time that an intentional walk was issued for all cases where that percent was great than one half.

Table 12 – Win Probabilities: bottom of the 9th, two out

runners	0 out				1 out				2 out			
	IBB/ 100PA	before IBB	after IBB	diff	IBB/ 100 PA	before IBB	after IBB	diff	IBB/ 100 PA	before IBB	after IBB	diff
2nd					2.4	.65	.86	.21	5.0	.28	.41	.13
3rd					3.2	.97	1.08	.10	3.8	.35	.43	.08
2nd/3rd	3.6	1.91	2.14	.23	12.3	1.28	1.50	.22	8.1	.53	.78	.25

Because of the inning and score situations, the win value can win be less. The first table in this article indicates a run difference of about .16 (.016 wins), but a win difference of only .007.

Overall

After all this analysis, however, the effect on winning games is pretty small. The average team issues about forty intentional walks during a season. If you lost one tenth of a run every time, it would still only cost you less than half a win.

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