By the Numbers

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Review

Academic Research: Three Papers

Charlie Pavitt

The author reviews three recent academic papers: one investigating the effect of the military draft on the timing of the emergence of young baseball players, another investigating pitch selection over the course of a game, and a third modeling pickoff throws using game theory.

I haven't found any truly outstanding contributions in the academic literature of late, but here are three I found of some interest.

Mange, Brennan and David C. Phillips (2016), Career interruption and productivity: Evidence from major league baseball during the Vietnam War era, Journal of Human Capital, Vol. 10, No. 2, pp. 159-185

Mange and Phillips conducted a study of interruptions caused by draft status during the Vietnam War. At that time, American males of military draft-eligible age were assigned a randomly-chosen "draft number" based on their birthday (mine was 90), and those below a given figure (the authors report these as 195 in 1970, 125 in 1971, and 95 in 1972 and 1973) were subject to being drafted. This allows comparisons between those under and over those figures.

(Personal note – given that my number was below 95, I was called up, went for, and passed the physical; but a physician there told me that nobody was being drafted anymore due to the war winding down. In other words, practically speaking, the draft ended during 1973.)

Results showed that days subject to the draft produced fewer MLB players on average (.34 versus .42) and, for those successful at making the majors, lower productivity (rWARs of 4.44 versus 5.85) in slightly less service time (6.66 versus 6.82 seasons). The effect was apparent across all player ages although attenuated in the last half of careers. It was most evident at the highest production levels; the top ten rWARs and all six Hall of Famers from those birth years were all born on "non-draft days."

As some potential players below the "magic number" did not serve due to student deferments (among other reasons), and some potential players above the figure did serve as volunteers, these figures likely underestimate the actual differences between those who did and did not actually serve. The authors presented data suggesting that the main reason for this effect may be a greater likelihood of potential players opting for four-year college rather than beginning careers after high school or two-year college, either to obtain student deferments or, after service, to receive free tuition under the GI Bill.

In this issue

The previous issue of this publication was March, 2016 (Volume 26, Number 1).

Whiteside, David, Douglas N. Martini, Ronald F. Zernicke and Grant C. Goulet (2016), Change in a starting pitcher's performance characteristics across the duration of a major league baseball game, International Journal of Sports Physiology and Performance, Vol. 11, pp. 247-254

The impact of workload within a game seems to have received far less attention than across games. Whiteside, Martini, Zernicke and Goulet used PITCHf/x data along with information from

FanGraphs to examine within-game changes in pitching, using 129 starters' appearances as their sample. The proportion of "hard pitches" (fastballs, sinkers, and cutters) decreased from the second through sixth innings relative to breaking and off-speed pitches, although innings 7 through 9 (for the pitchers lasting that long) showed a reversal of that tendency. The former finding is not surprising given normal pitching strategy, while the latter likely indicates the repertoires of pitchers lasting longer than average (reported as 5.8 innings) in games. Pitch speed for all three of these categories declined through about the 7th inning, with (once again) those lasting longer pitching faster at the end. Control (percentage of pitches in the strike zone) began a descent in the 5th inning that became significant by the 7th. The authors concluded that the data imply that the common practice of replacing the starter around the 6th inning is defensible.

Downey, Jim, and Joseph P. McGarrity (2015), Pick off throws, stolen bases, and southpaws: A comparative static analysis of a mixed strategy game, Atlantic Economics Journal, Vol. 43 No. 3, pp. 319-335

There seems to be little if any work on the strategy of pickoff throws, so Downey and McGarrity's work is a welcome contribution. They look at the issue at hand as a "cat and mouse" game between baserunners on first thinking about stealing and pitchers trying to keep them from doing so. Their data set consisted of all pitches (and attempted pickoffs) between June 9 and June 13, 2010, with a runner on first base during games in American League parks (the AL purposely chosen to sidestep the complexities involved with pitcher at-bats).

Several models imply that there are more pickoff attempts from right-handed pitchers than lefties, which the authors attribute to the idea that lefties have more success when they do try a pickoff, resulting in baserunners taking shorter leads and attempting fewer steals.

There were also more throws to first base with lower-OPS batters at the plate (allowing pitchers to concentrate more on the baserunner), a catcher less successful at throwing out runners (giving the pitcher a greater incentive to throw over), a closer game (increasing the baserunner's incentive to steal), better base stealers on first, and fewer balls and more strikes to the batter.

As for steal attempts, they increased with better basestealers, higher pitcher ERAs (more baserunners), a closer game score (as before), and right-handed pitching (again, with a lower expectation of success providing less incentive to attempt the theft).

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World Series Pinch Runners, 1990-2015

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.

Introduction

In the March, 2016 issue of *By the Numbers*. Bill Deane researched pinch hitting situations in World Series games from 1970 to 1989 and found that overall, the use of pinch running was ineffective. The data was strongly suggestive, but would benefit from additional sample size. I expanded Deane's study by looking at World Series from 1990 to 2015 to double the available data and see if the conclusion that pinch running was ineffective managed to stay true.

Examination

Using play-by-play data provided by *baseball-reference.com*, I was able to find every World Series pinch runner from 1990 to 2015. In those years, there was a total of 59 situations in which teams used a pinch runner. Out of those 59 instances, 13 of them led to runs scoring (22.03%). Combined with the numbers previously collected by Deane, this brings the 46-year scoring rate (1970 to 2015) to 19.2 percent -- 25 out of 130 instances.

But there are cases in which even though the runner did not score, the use of the pinch runner was effective. And, just because a run scored, that doesn't necessarily mean the pinch-running decision was the cause.

So, I deemed that any runner who was able to gain an extra base for his team -- via a stolen base, an extra base on a single or double, or even an extra base on a batted ball out -- was in fact effective in his role as pinch runner.

That criterion works out to 19 successes out of 59 instances, or a 35.6 percent effectiveness rate. Those 19 successes are listed in Table 1.

The pinch-runners were clearly significantly faster than the players they replaced on the basepaths. We can get an idea of their speed by looking at their "BsR" statistic for the season in question. (BsR, a statistic provided by Baseball Reference, measures by how many runs a player benefited (or cost) his team, compared to average, based on only his baserunning record.)

For the season, the average BsR of the 19 effective pinch runners was 1.7. The runners they replaced were at -3.0.

That difference shouldn't necessarily be taken at face value -- the BsR is the total regular season runs, and, therefore, is heavily dependent on playing time. And it's not that surprising that managers chose to substitute above-average runners to replace below-average runners.

However, it should also be noted that the difference was not as high for the *ineffective* pinch-runners. On average, those players were 0.8 for the season, replacing runners who were -1.0. It's a small sample size, but the effect does go in the expected direction.

Table 1 – World Series Pinch-Running Successes, 1990-2015

	gm	inning	team	pinch runner	running for	outcome
2015	5	12th	KC	Jarrod Dyson	Salvador Perez	SB (2nd) then Scored
2013	2	7th	STL	Pete Kozma	David Freese	SB (3rd) then scored on SF
2013	4	8th	BOS	Quintin Berry	David Ortiz	SB (2nd) Then inning ended
2011	3	8th	STL	Daniel Descalso	David Freese	Scored from 1st on a double
2009	2	7th	NYY	Brett Gardner	Jerry Hairston	Advanced to 3rd on 1B, then scored
2008	5	7th	PHI	Eric Bruntlett	Pat Burrell	Advanced to 3rd on GB then scored
2008	5	9th	TB	Fernando Perez	Dioner Navarro	SB (2nd) but did not score
2005	1	8th	HOU	Chris Burke	Lance Berkman	SB (2nd) did not score
2005	3	8th	HOU	Eric Bruntlett	Mike Lamb	Advanced to 3rd, did not score
2005	3	8th	CHW	Willie Harris	Carl Everett	SB (2nd) did not score
2003	4	6th	NYY	David Dellucci	Jorge Posada	Scored from 1st on a triple
2001	7	9th	ARI	Midre Cummings	Damian Miller	Scores from 2nd off double
2000	3	8th	NYM	Joe McEwing	Benny Agbayani	Scores on Sacrifice Fly
1998	3	9th	SD	John Vander Wal	Carlos Hernandez	Advanced to third, did not score
1996	2	9th	NYY	Andy Fox	Cecil Fielder	Advanced to 2nd, did not score
1996	4	9th	NYY	Andy Fox	Cecil Fielder	Advanced to 3rd, did not score
1993	5	8th	TOR	Willie Canate	Pat Borders	Advanced to 3rd on single
1992	2	9th	ATL	Ron Gant	Lonnie Smith	SB (2nd) did not score
1991	7	9th	MIN	Jarvis Brown	Chili Davis	Advanced to 3rd, did not score

Situations

But the question still stands as posed by Mr. Deane: Has a pinch runner ever been the difference to win a game for his team?

I will attempt to answer this in the same method in which Mr. Deane did: by going through the 19 cases I deemed effective earlier in this paper to see how many of those pinch runners actually were able to do a better job in comparison to the runner they replaced.

In nine of the 19 cases can it be concluded that the input of the pinch runner improved the chance of scoring, making it a wise choice and an effective strategy. This is an improvement on the one-out-of-12 cases Deane found, but it is still tells us that most of the time, the use of a pinch runner will not make a difference.

Here are the 19 cases:

2015 Game 5: With nobody out in the top of the 12th inning, the Royals' Jarrod Dyson came in to pinch run for Catcher Salvador Perez at first base.. With Alex Gordon batting next, Dyson stole 2nd base on a 2-0 count. Gordon then grounded out to first base, and Dyson advanced to third. Christian Colon, the next batter in the lineup, singled into left field scoring Dyson. Conclusion: This was the first of five runs that the Royals scored in the inning, so even if Salvador Perez not been pinch hit for, he still would have come around to score.

2013 Game 2: With John Jay on first base and David Freese on second, the Cardinals' Pete Kozma came in to pinch run for Freese with one out in the seventh inning. Kozma and Jay completed a double steal, and the Cardinals scored two runs off a sacrifice fly and a throwing error by the Boston Red Sox. Conclusion: Freese did not have the speed to complete the double steal, but pinch-runner Kozma did. If there had been no double steal, there would have been no sacrifice fly and likely no runs scored in that inning. Instead, the Cardinals were able to score three runs and take a 4-2 lead over the Red Sox. This was the final score in their Game 2 World Series victory.

2013 Game 4: Quintin Berry came in for the Red Sox to pinch run for David Ortiz at first base with two outs in the top of the 8th. Berry then proceeded to steal second base. But after a walk and a strikeout, Berry remained stranded at second. Conclusion: Berry's steal of second base may not have ended up in a score, but it did increase Boston's chance to score a run with two outs while also increasing their chance at victory.

2011 Game 3: The Cardinals' Daniel Descalso came in to pinch run for David Freese at first base with one out in the top of the 8th. In the ensuing at-bat, Descalso scored off a double to center field. Conclusion: Daniel Descalso is significantly faster than David Freese; we can assume that Freese would not have scored on the double. That would have cost the Cardinals a valuable run, as the Cardinals did not get a hit the rest of the inning and Freese would have been stranded at third base.

2009 Game 2: The Yankees' Brett Gardner came in to pinch run for Jerry Hairston at first base with no outs in bottom of the 7th, with New York ahead 2-1. Gardner advanced first-to-third on a single and then scored on a single in the following at-bat. Conclusion: It could be assumed that Hairston would not have reached third on the first single. The next two at-bats were a ground out directly to first base, followed by a double play. Hairston would not have scored, which would have left the Philadelphia Phillies with a better chance to win the game.

2008 Game 5 (Phillies): Eric Bruntlett came in to pinch run for Pat Burrell on second base with no outs in the bottom of the 7th inning. Bruntlett was able to advance to third on a ground ball to second base and then score on the next play. Conclusion: Even with Burrell's not so fast demeanor, he more than likely would have been able to score in the situation in which Bruntlett did, making the appearance of the pinch runner ineffective.

2008 Game 5 (Rays): In this elimination game, Fernando Perez came in to pinch run for Dioner Navarro on first base with the Tampa Bay Rays down 4-3 in the top of the ninth and one out. Perez was able to steal second and get himself in scoring position to tie the game. But after a lineout and strikeout, the game, and the series, was over. Conclusion: In this scenario, the pinch runner gave the Rays the best chance to win the game, but in the end it takes more than a good runner to score. But this does not take away from the fact that the decision to put in a pinch runner was a good one.

2005 Game 1: Chris Burke came in to pinch run for Lance Berkman at first base with runners on first and third and two out, with the batting Astros trailing the White Sox by a run. Burke stole second base, but then a strikeout ended the inning. Conclusion: This could have been the moment that a pinch runner brought in the winning run in a ball game. Burke was able to do something that Berkman could not have, stolen second base.

2005 Game 3 (Astros): Eric Bruntlett came in to pinch run at first base for Mike Lamb of the Houston Astros with 2 outs and runners on first and second in the bottom of the 8th inning. The following batter hit a shallow double between shortstop and third base; that scored the runner on second, and advanced Bruntlett to third. But then Bruntlett was unable to score as a strikeout ended the inning. Conclusion: The fact that the double in this scenario was able to be hit at the shortstop shows how Bruntlett's speed was able to make this possible. With Lamb on base it more likely would have been a scenario with runners on 1st and 2nd rather than 2nd and 3rd, a very significant difference.

2005 Game 3 (White Sox): Willie Harris came in to pinch run for Carl Everett of the Chicago White Sox at first base with one out in the top of the 8th inning. Harris was able to steal second base, but after a fly out and ground out, the inning came to an end. Conclusion: Harris did his job by stealing second base, and even though he was unable to score, he was effective as a pinch runner as he increased his team's chances to win and did something that the previous runner in Carl Everett would most likely not have been able to do. (Everett was successful stealing bases only 44.4% of the time -- he went 4 for 9 on the season -- while Harris had a success rate of 77 percent, going 10 for 13 in 2005.)

2003 Game 4: In the top of the ninth, David Dellucci came in to pinch run for Jorge Posada at first base with two out and two runners on. Dellucci scored the tying run on a triple to right field. Conclusion: Not only was Delucci the tying run in the ninth inning of a World Series game, but he was so much faster than Posada (3.4 BsR compared to -5 BsR) that it can be assumed that Posada would not have scored on that triple (which would have then been a double) and the Yankees would not have won the ball game.

2001 Game 7: With his Diamondbacks trailing the Yankees 2-1, Midre Cummings came in to pinch run for Damian Miller with one out in the bottom of the ninth and men on first and second. Cummings came in to score the tying run on a double to right field. The Diamondbacks would win the game 3-2, and the World Series 4-3. Conclusion: This seems to be a case where the pinch runner actually led to a victory. But when examining this more closely, the two players don't seem to be much different in terms of baserunning ability. Cummings was a perfectly average baserunner with a BsR of 0.0 runs and he replaced Damian Miller with a BsR of -0.5. Also, neither had shown strong evidence of above-average speed in their statistics, although Cummings had hit six triples four seasons prior, and had been a speedy centerfielder when drafted by the Twins back in 1990. Still, it can be assumed that Miller would have been able to score on the double just as Cummings had, making the use of the pinch runner one that made no significant difference.

2000 Game 3: Joe McEwing came in to pinch run for Benny Agbayani of the New York Mets at second base with one out in the bottom of the 8th. McEwing advanced to third on a single and scored on a sacrifice fly. Conclusion: McEwing did his job as the pinch runner and scored off the sacrifice fly. McEwing did not have a significantly higher BsR than Agbayani, but was clearly a better baserunner as evidenced by other stats, such as stolen base and triples success rate. This suggests that Agbayani might not have scored if he had been left in, making the use of a pinch runner effective in this scenario.

1998 Game 3: John Vander Wal came in to pinch run for Carlos Hernandez of the San Diego Padres with two out and a runner on first with the Padres trailing 5-4 to the New York Yankees. Vander Wal advanced to third on a single to the right side but did not score as a strikeout in the following at-bat ended the game. Conclusion: Vander Wal, as a significantly faster baserunner than Hernandez, gave his team a better chance to win by advancing to third on the single.

1996 Game 2: Andy Fox came in to pinch run for Cecil Fielder of the New York Yankees in the bottom of the 9th with two outs and a man on first base. Fox advanced to second on defensive indifference and then the game ended with a strikeout in the following at-bat. Conclusion: Fox did nothing that the previous runner could not have done.

1996 Game 4: Again, Andy Fox came in to pinch run for Cecil Fielder -- this time at second base -- with the game tied and runners on first and second. Fox advanced to third on an infield single to the pitcher, one on which there wouldn't have been a play even with Fielder on second. But Fox failed to score after a lineout ended the inning. Conclusion: Again, Fox did nothing that Fielder could not have done, despite the obvious difference in speed.

1993 Game 5: Willie Canate came in to pinch run for Pat Borders of the Toronto Blue Jays in the top of the 8th inning with a runner on first, no outs and the Blue Jays trailing 2 to 0. Canate managed to advance to third on a single to right field. But Canate was thrown out at home and the Blue Jays were unable to score. Conclusion: This use of a pinch runner turned out to have no positive effect for the Blue Jays, as the faster Canate was thrown out on the basepaths.

1992 Game 2: Ron Gant came in to pinch run for Lonnie Smith of the Atlanta Braves at first base with one out in the bottom of the 9th and the Braves trailing 5- 4. After the next batter lined out, Gant stole second base. But that was as far as he would get before the inning, and the game, ended. Conclusion: Gant gave his team the best chance to win by putting himself in scoring position with the steal. Even though the hitting did not come through, it was effective pinch running.

1991 Game 7: In a scoreless game, Jarvis Brown came in to pinch run for Chili Davis of the Minnesota Twins with nobody out and a man on first, in the top of the 9th inning. Brown was able to advance to second on a bunt single and then to third on a double play ground ball, but did not score and the game remained 0-0. Conclusion: None of the plays made by Brown were ones that Chili Davis would not have been able to do himself. As a result, the use of the pinch runner had no impact on the outcome.

Conclusion

Out of these 19 cases where there was an argument that these pinch runners were “effective,” eleven could be deemed truly beneficial for their team based on statistics and the specific scenario. As I stated earlier, this is an improvement from Deane’s sample; that could be a indication of the improvement of the use of the pinch runner through the history of baseball. More than ever, fans can see players who are specifically put on their favorite team with the sole intention just to be able to go out as a pinch runner and get the team an extra base, whether that is through stealing a base or getting from first to third on a hit into the shallow part of the infield.

The question that is being asked for the sake of this research is whether or not pinch running is effective in Major League Baseball. When done correctly, the answer is yes. Putting in a runner who is statistically a better base runner or a faster base runner is never going to decrease the odds of a team winning a game. As the league continues to add players to rosters and add more value to players who can run, one will see the ways teams run the bases improve.

That was seen clearly in 2016. The Cleveland Indians made their way into the 2016 World Series with an 81 percent success rate stealing bases, second highest in baseball. The year before that, the champion Kansas City Royals were 5th in MLB with a 75 percent success rate, totaling 104 stolen bases on the year.

Indians' manager Terry Francona. who has managed three World Series champion teams, has used base stealing and pinch running in key situations in key games during his postseason career. Starting with Dave Roberts stealing second base in the AL Championship Series in 2004, continuing with Quintin Berry helping the Red Sox in their 2013 World Series victory over the St. Louis Cardinals and most recently this season as the manager of the Indians, Francona has managed a top-7 base stealing team in every season he has been at the helm, using baserunning ability to take advantage of pitchers like the Cubs' Jon Lester, whose greatest weakness is the lack of a pickoff move.

In terms of expanding upon the research which was done by Bill Deane, I would say the trend is going towards pinch running being an effective method in increasing run production and win expectancy. In the games which matter most, the timely and appropriate use of the pinch runner can be the key in giving any manager the edge of one or two runs which could be the difference between winning or losing.

Perhaps, similarly to how the Tampa Bay Rays used defensive ability as a more cost effective way to win rather than buying big bats, teams are using baserunning as a more cost effective way to win ballgames. This, of course, is speculative.

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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.

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Pitcher Batting Eighth

Pete Palmer

A few teams, most notably the St. Louis Cardinals, have tried a strategy of batting the pitcher eighth instead of ninth. Does it help? How much difference does it make? Here, Pete Palmer investigates by running Markov simulations.

The idea to have the pitcher bat eighth (instead of ninth) has attracted some interest recently. That is, as a deliberate strategy; pitchers typically "accidentally" bat in the eighth slot about ten times a year per league, probably due to double switches.

The first team to deliberately try the strategy was the 1998 Cardinals, who gave 162 at-bats to eighth-batting pitchers. After that, there was an eight year gap, until the Cards did it again for 99 AB in 2007. St. Louis continued to use this strategy through though the 2010 season; 2008 was their peak, when they gave pitchers 441 [eighth slot] at-bats in 2008. That year, Milwaukee had 87 at-bats and Pittsburgh 58. The Cards followed with 128 AB in 2009 and 169 AB in 2010, but no one else had over 50 either year.

The strategy just about died out in 2011-14, with the peak being St. Louis with 29 AB in 2011. However, 2015 showed a rebirth with 605 at-bats, led by the Cubs with 316, Reds with 119 and Mets with 58.

In 2016 there were 367 at-bats overall, third highest all time. But the Cubs and Reds, who had the most in 2015, dropped to only a few (28 and 23, respectively). Arizona had the most, with 70; San Francisco and Philadelphia had 63. All three of those teams had had very few in 2015 (11, 4 and 0). Nine teams had 10 AB or more, compared to seven teams last year, the previous high. It looks like a fad to me.

One interesting thing in 2016 was that the Angels batted their pitcher eighth every [non-DH] game. They accounted for 20 AB out of the American League total of 28.

Simulation

Back in the 1970s, I wrote a program which allowed entering data for the nine batting positions, then calculating runs scored per game. It was a Markov algorithm, which means instead of picking a random number for each event, it was deterministic, as the flow was divided proportionally for each possible outcome. I did have to run nine half innings, one for each player leading off. Using the distribution of number of AB for each player leading off, I could count up the number of times these innings occurred and tally up the runs for the game.

If you actually played the game through nine innings to the end, the strands would get pretty small and you could lose some data, but for an inning, it was manageable. In theory, an inning could go forever, so the algorithm would never end, but I just kept playing the inning until it was .99999 complete and skipped the rest.

The advantage to the Markov method, as opposed to random number simulation, is that you can get an exact answer for the given input conditions almost instantaneously. One restriction is that player performance is independent of inning and score. Also, any interaction between batters, like stolen bases or hit and run, are ignored, as well as any psychological factors that might affect a batter because of his spot in the lineup. As we will see, the overall effect on hitting is so small, I doubt these other factors would matter.

For my simulation, I took the average performance in each batting slot for the NL from 2001-15. I included figures for sacrifices with none out or one out, intentional walks by slot, and assumed that advances on outs, wild pitches, passed balls and balks were the same for all batters. I gave each batter a .015 chance of reaching on error.

Table 1 shows the overall batting lines, normalized to 500 PA. The "9p" line shows only pitchers in the ninth slot, while the "9" is all ninth-place hitters. The pitcher actually ends up covering only about half of the ninth slot -- the rest is composed of pinch hitters (with a few double switches and DH games) -- so the overall batting from the ninth spot is not as terrible as you might think.

Bottom line: the standard lineup scored 4.5668 runs per game. Swapping eighth and ninth batters reduced this to 4.5602. The "pitcher bats eighth" strategy resulted in lower scoring -- a whopping reduction of one run per season.

The idea behind the swap was that the top of the lineup would have more runners on base when it came up after the first inning. This is true, of course (adding about .05 runs per game with the 9th slot leading off), but scoring for most of the other innings was reduced. One of the factors contributing to the reduction, of course, is that when you bat pitchers eighth, they steal about twenty at-bats per season from the regular eighth-place hitter.

Table 1 – Batting by lineup position, NL, 2001-2015

	AB	H	2B	3B	HR	K	BB	BA	OBP	SLG	OPS
1	462	123	23	5	9	77	38	.267	.323	.396	.719
2	462	124	24	3	10	78	38	.269	.324	.400	.724
3	450	127	27	2	19	84	50	.283	.354	.480	.834
4	453	124	26	2	21	92	47	.273	.341	.474	.816
5	458	120	26	2	17	96	42	.262	.324	.437	.761
6	462	119	25	3	15	98	38	.258	.314	.419	.733
7	465	117	24	2	12	95	35	.253	.305	.394	.699
8	466	113	22	3	9	94	34	.243	.295	.360	.655
9	472	85	15	1	6	152	28	.179	.225	.253	.478
9p	482	67	11	1	2	186	18	.140	.171	.179	.350

If I ran the simulation with just pitcher batting in the ninth slot – that is, the "9p" slot from the table instead of the "9" -- I got 4.3928 runs. Moving the pitcher to eighth produced 4.3868 runs. The difference was just about the same, .0060 instead of .0066. The variation among innings was greater, gaining .0946 runs with the ninth batter leading off but losing more from the other cases. This would only happen about half as often in real life as compared to the simulation, though, since the pitcher does not always occupy the ninth slot.

Thus it appears that it makes very little difference whether you bat the pitcher eighth or ninth.

Notes

1. Varying the lineup has a very small effect on run scoring, a signal that's overwhelmed by the noise of random variation. The standard deviation for runs is equal to the square root of twice the number of runs, so if you did a random number simulation for a year – say, 700 runs in 162 games -- the standard deviation would be square root of 1400 divided by 162. That's .23 runs per game, or 37 runs over a season -- which is much greater than the one-run difference a different lineup might make.

Because of that, it's hard to measure the effect of batting order with a traditional random-number simulation. To reliably measure a difference of one run per year in the context of 37 runs of variation, you would have to reduce the SD to 3 runs or so, which is one hundredth of the one season variation. This would mean running 10,000 seasons for each lineup measured using the random number simulation.

2. Just for fun, I decided to look at the entire set of 362,880 possible lineups (9 factorial). Using the Markov simulation, it only took about three hours.

The normal lineup produced 4.5668 runs. The absolute best lineup produced 4.5679 runs, which was two tenths of a run per year higher. This of course would vary with slight changes in the data for the various slots, so the results aren't totally reliable, but, for the record, that best lineup was 235417689, followed by 245361789, 435126798, and 254361789. The worst was 892176543 (4.4321 runs/game), followed by 192876543 (4.4325), and 892175643 (4.4329). These cases were about 20 runs a year below the best lineup.

Nine percent of the lineups (32,812) were within 5 runs per year of the best.

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Two Strategies: A Story of Change

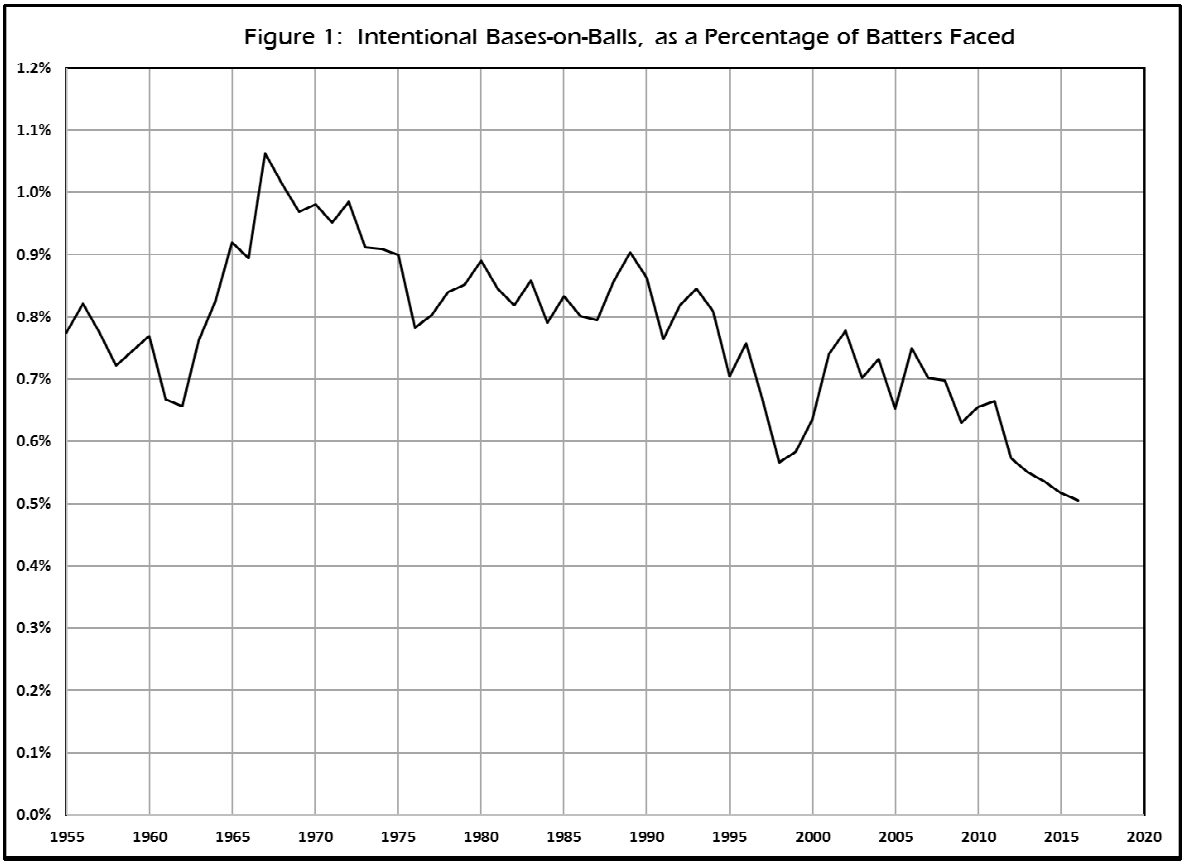
Donald A. Coffin

The sacrifice bunt and intentional walk are two strategies that sabermetricians have long argued are overused. Here, the author shows how their use has changed over the past 60 years. As it turns out, both have declined significantly.

It's fairly well known that people who do quantitative analysis of baseball strategies have long argued that there are two fairly common managerial strategies that have little, if any, positive value—intentional walks and sacrifice bunts. I'm not going to address the accuracy (or otherwise) of that conclusion, but I am going to ask what has happened, over time, to the use of them. To anticipate my results: They are both less than half as common as they were 60 years ago.[1] I will also suggest a reason for the decline in the use of these strategies.

Intentional Walks

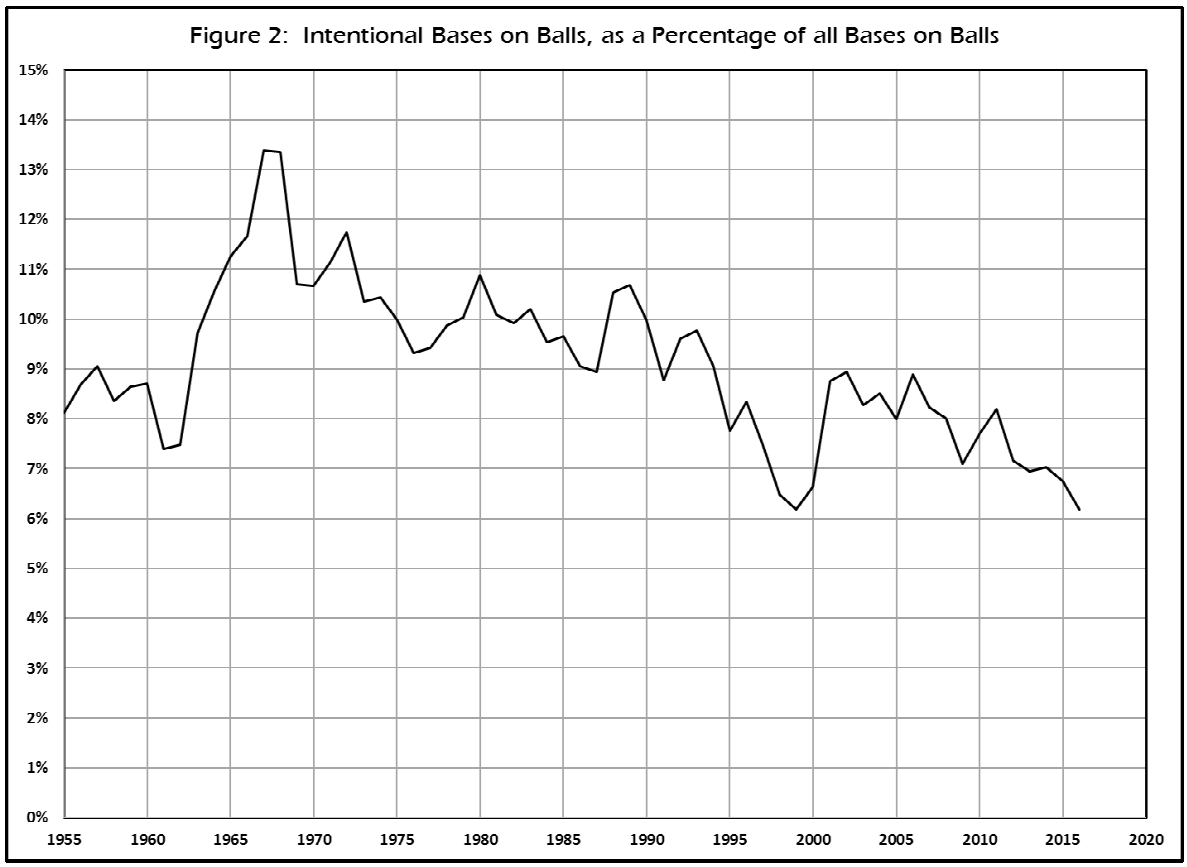
Figures 1 and 2 show two ways of looking at intentional walks. Figure 1 is intentional walks as a percentage of batters faced by pitchers, and Figure 2 is intentional walks as a percentage of all walks. Either way, the story is the same. Intentional walks became more common between



[1] I'm looking at the 1955 – 2016 period; intentional walks were not recorded before 1955, and I chose to start my analysis of both strategies with the same year. All data used here are from baseballreference.com.

1955 and 1967, increasing by about 40% as a percentage of batters faced (0.77% to 1.06%) and by about 55% as a percentage of walks (8.13% to 13.40%).[2] Then the decline began, and it has been almost continuous (year-to-year fluctuations not mattering much), reaching its all-time low in 2016, at 0.50% of batters faced (6.18% of walks).

I would argue that the magnitude and persistence of this trend is clear evidence that major league baseball managers have decided that intentional walks are not as valuable/useful a strategy as they were believed to be as late as 1967. Why might this have been the case? The easiest explanation I can find is that the frequency of home runs began to rise around 1970, and has continued to rise, reaching a peak in 2016 of 1 home run roughly every 30 plate appearances (a rate of 3.07% of batters faced). Related to this, overall slugging percentages began to rise in the late 1960s, from .357 in 1967 to .419 in 2016; "isolated power"—slugging percentage minus batting average—also bottomed out in the late 1960s (in 1968, at .103) and is now at an all-time high of .162 (2016). This increase in power means that the potential cost of an intentional walk has increased. Unsurprisingly, managers have reacted to this.



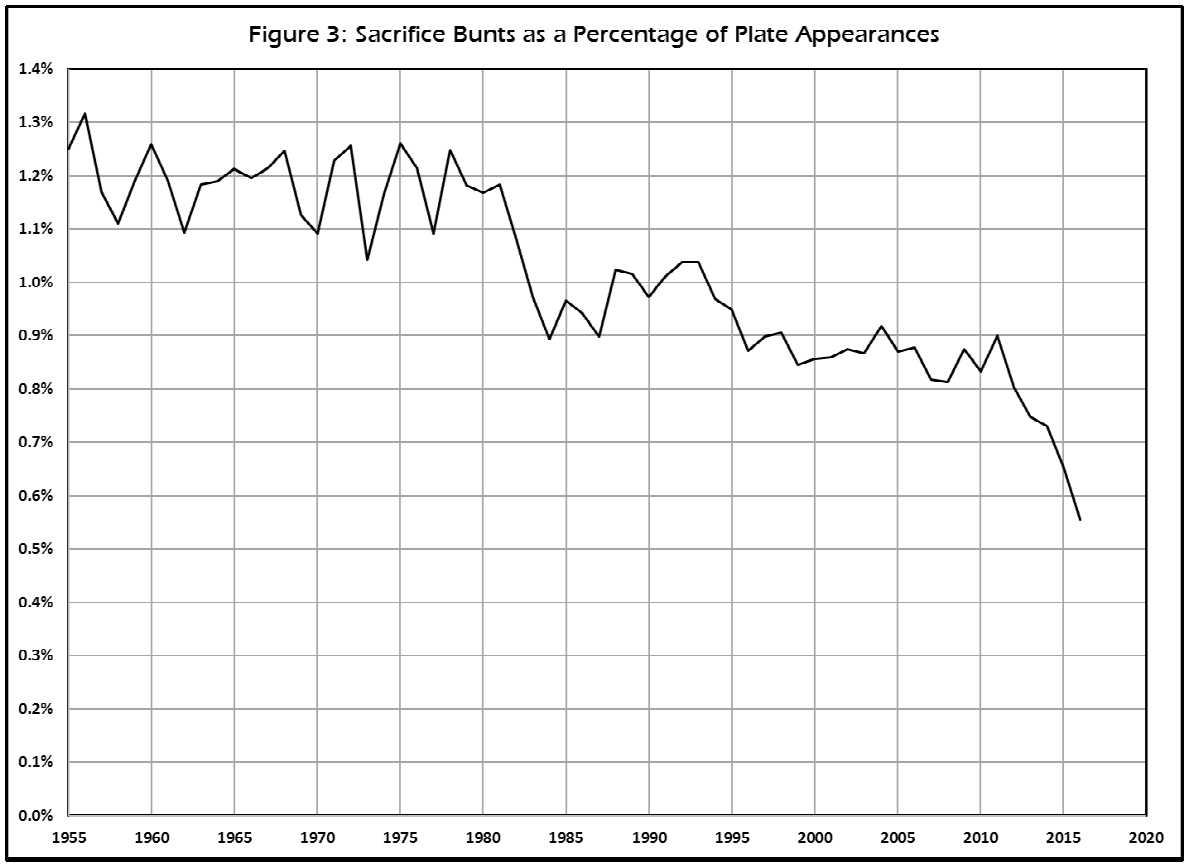
[2] Overall, walks as a percentage of batters faced fell from 9.52% to 7.93% between 1955 and 1967.

Sacrifice Bunts

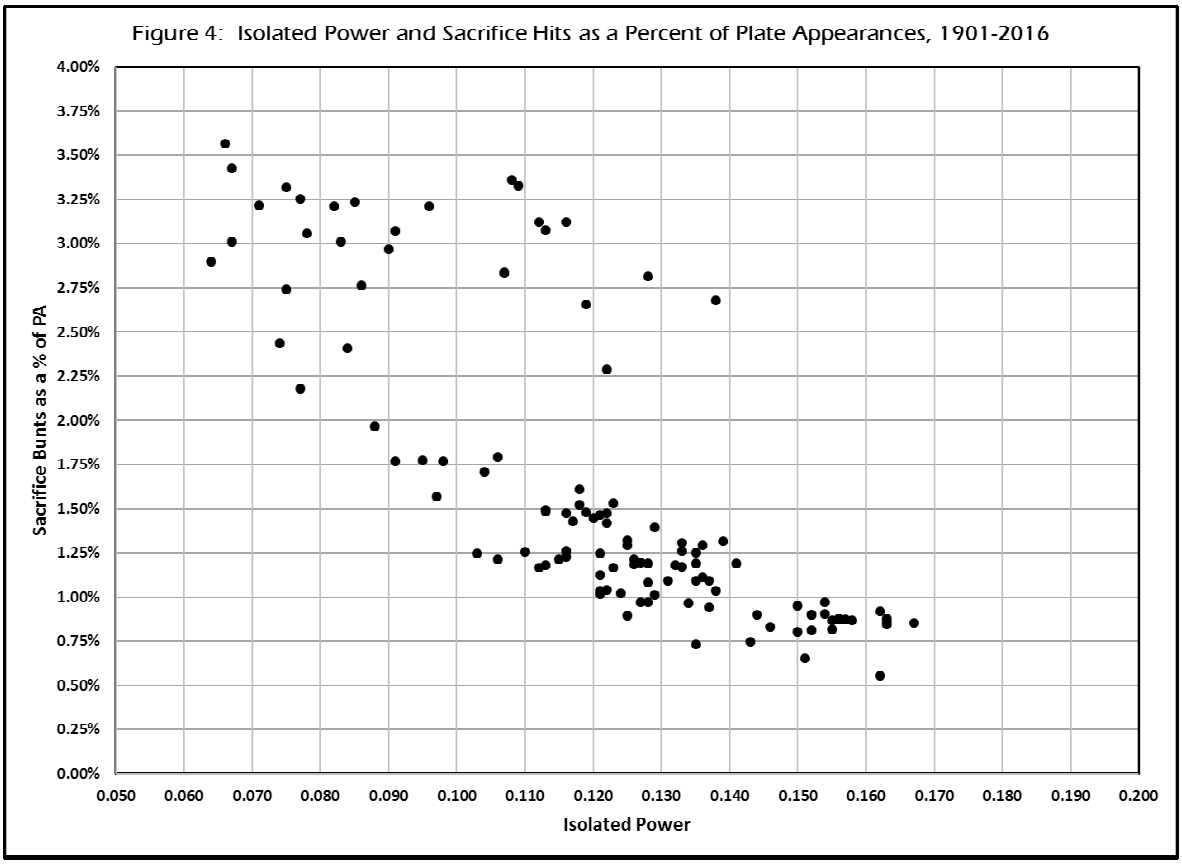
The decline in sacrifice bunts did not begin in the mid-1950s. It's difficult to figure the exact decline, because of repeated changes in how sacrifices were counted during the first half of the century.[3] But, we can take 1931 as a representative example, a season where the SH category meant the same thing as it does today.

That year, sacrifices constituted 1.49% of plate appearances -- higher than any season in the past 61 years. The highest since 1955 was the 1956 season, with slightly over 1.3%, as Figure 3 illustrates. Sacrifices fell fairly steadily after that, to today's lows.

The reason seems clear, as Figure 4 shows: As power (measured here by isolated power) increased, sacrifices decreased. The increase in power means that "scoring position" can, increasingly, be thought of not as a runner on second or third, but as any baserunner on any base. Including the batter.

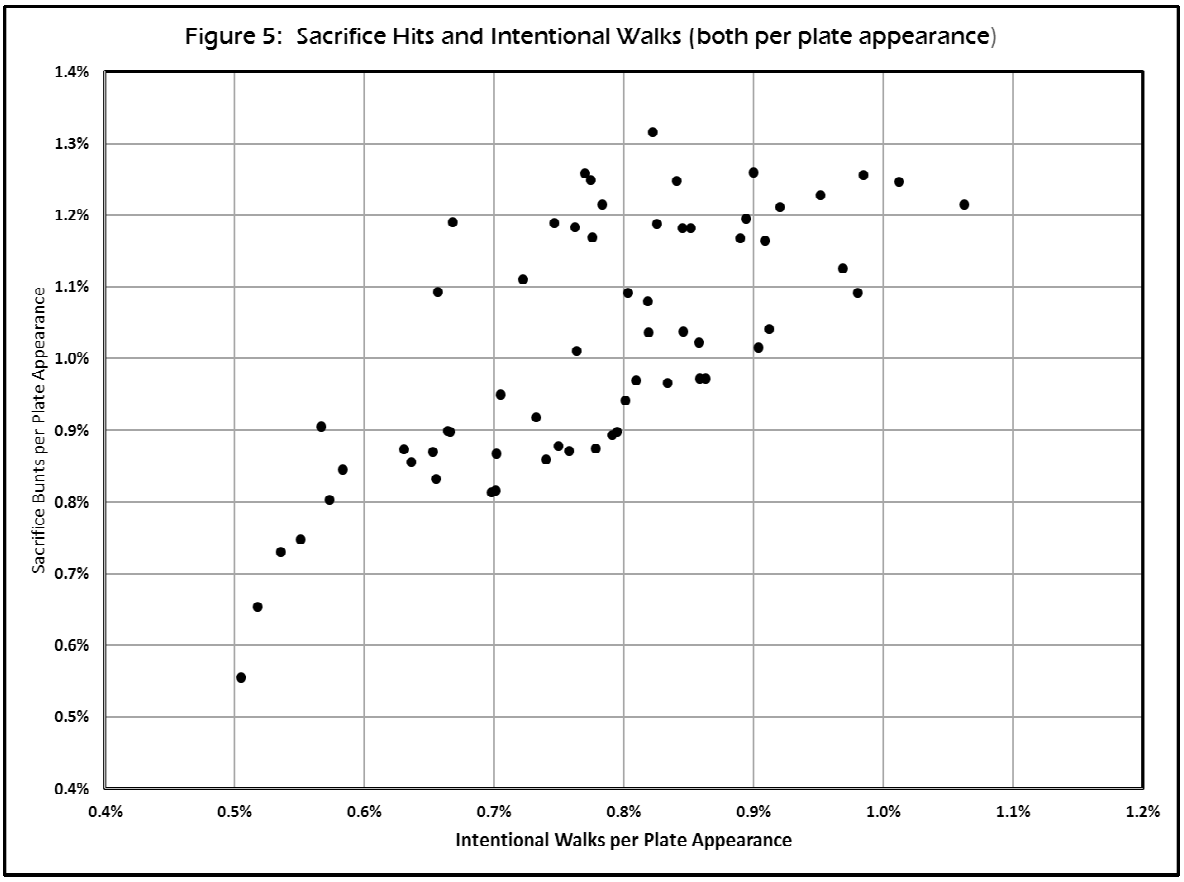


[3] From 1908 to 1930, the first period where sacrifice flies were awarded, sacrifice bunts and sacrifice flies were added together in one number. From 1927 to 1930, a sac fly was credited for any advance of a runner. In 1939 (only), sacrifice flies counted only when they scored a runner -- but again they were added to sacrifice bunts. Starting in 1954, SH and SF were counted separately, as they are today.



Strategies are not Independent

What this analysis suggests if that the choice of strategies is not independent. The increase in hitting for power—which is almost continuous from 1901 onward—reduces the value of walking one hitter for the (hoped-for) greater probability of retiring the following hitter(s), simply because the additional baserunner increases the potential cost of an extra base hit. Conversely, the gain from a sacrifice bunt becomes smaller as power increases. The ability of subsequent hitters to drive in a baserunner from first mitigates the gain from moving the runner up a base—the cost of giving up an out is larger. So we would expect the use of both of these strategies to decline, and to decline together—which (see Figure 5) they do.



Obviously, neither sacrifice bunts nor intentional walks have disappeared. But both are much less common. This suggests two things. First, managers learn and adapt. Second, so long as hitting for power continues to increase, I would expect both sacrifice bunts and intentional walks to continue to decline.

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