Are outs made on the bases more harmful than other types of outs?

There is a related question, which is something of a mirror image which would be "How valuable are 'Productive Outs'?" but that is not my topic today.

We have all heard announcers (as well as managers and players) speak of the psychological ("intangible"?) effects of certain plays beyond their immediate effect on the play. A famous example is the claim that a leadoff batter who walks is more likely to score than a leadoff batter who reaches first on a hit since it supposedly indicates larger problems for that pitcher. This is demonstrably untrue, as has been shown by several researchers, including me, but it is still widely quoted. Such is the nature of "conventional wisdom."

There are many other examples in which assertions are made in the absence of data, because they "feel right." For example, last year I explored the claim that pitchers who become baserunners are harmed when they take the mound the next inning. I found no evidence to support this notion; pitchers do <u>not</u> perform at a lower level in these cases. There are other examples as well. Of course, all of the cases I study require the analysis of play by play data.

At first glance, my topic this year is just an examination of another example of conventional wisdom and I think the results of that are interesting. However, this one goes further in that it slides into a revised look into some of the assumptions of a mainstream Sabermetric measurement. I will return to that in a while.

So what exactly did I investigate this year? The title of this presentation is: "Are outs made on the bases more harmful than other types of outs?" Those who answer in the affirmative refer to "overly aggressive baserunning" and have some favorite aphorisms such as "never make the first or third out at third base."

How can theis questions be addressed in an objective way with solid evidence? The best way I can think of is to do a comparative examination of scoring in an inning after each game situation. This calculation of "expected runs" has been carried out by many researchers and has been used in several ways. For example, Tom Ruane has expanded Gary Skoog's proposal of studying the "value added" by a batter (http://www.retrosheet.org/Research/RuaneT/valueadd_art.htm) and Mark Pankin has done many different studies, for example looking at optimal lineups, that are based on this situational analysis (http://pankin.com/baseball.htm). Both Tom and Mark examined transitions in a way which I will oversimplifiy as follows: what is the chance of scoring before a given batter's action compared to the chance afterwards?

As we get into the detailed data, I will begin with my usual practice of listing the number of games and plays that I examined.

Table 1. Scope of study

Years	1901 to 2009 (109 seasons)
Games with play by play	139,516 (80.1% of total)
Plays analyzed	10,921,610 (first time over 10 million!)

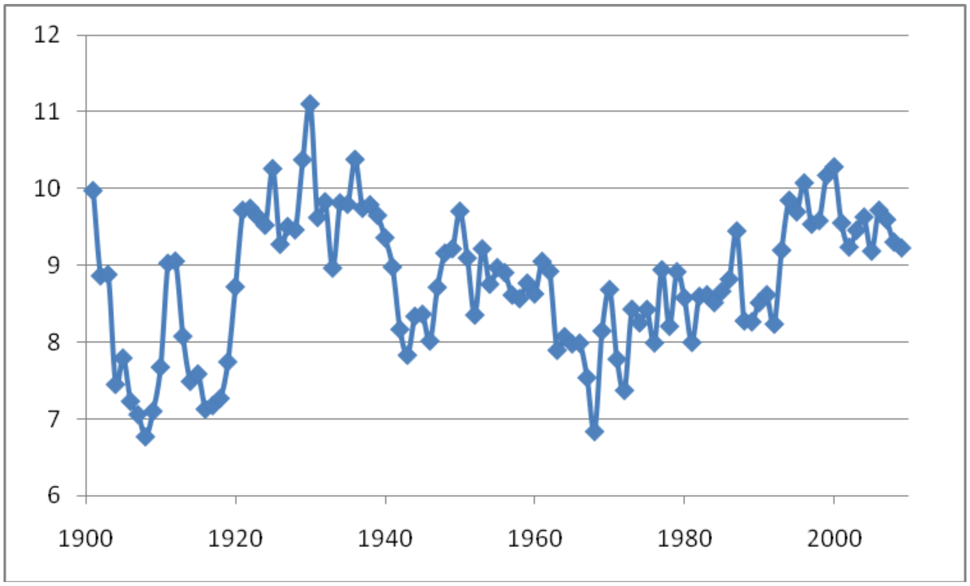
There are 24 possible combinations of outs and men on base at the start of each play, usually referred to as game states. I began by examining each play and tallied how many runs scored in the inning after that play. The number of runs scored after each situation was then divided by the total number of occurrences of that situation to get the expected runs. Table 2 has the expected runs for my full data set.

Table 2. Expected runs after each game state, aggregated for 1901-2009.

TSF	0 out	1 out	2 out
000	0.49	0.26	0.10
001	0.87	0.52	0.22
010	1.11	0.69	0.33
011	1.51	0.93	0.44
100	1.35	0.94	0.38
101	1.75	1.17	0.51
110	1.98	1.39	0.60
111	2.32	1.56	0.77

The first note of importance is that these values will vary in eras of different offensive production. For example, the lowest value I found for the 0 out, none on situation was 0.38 in 1968 and the highest was 0.64 in 1930. However, it can be tricky to decide exactly where to draw the lines to establish different eras. Figure 1 presents the average runs per game (both teams combined) from 1901 through 2009 to illustrate the problem. Too much aggregation can obscure differences between eras, but if too many subdivisions are created, then analytical power is lost because the data in each group is diminished.

Figure 1. Runs per game (both teams combined), 1901-2009



Since the effects I am interested in here should not depend very much on the level of offensive production, I decided to make no subdivisions and I have aggregated all the data for the 109 seasons. It is also important to note that the different game states occur in extremely uneven proportions. I have seen this fact reported much less often, so I compiled Table 3.

Table 3. Percentage occurrence of each game state, aggregated for 1901-2009.

TSF	0 out	1 out	2 out
000	23.3	16.5	13.0
001	6.2	7.1	7.1
010	1.7	3.2	3.9
011	1.4	2.5	3.2
100	0.4	1.1	1.6
101	0.6	1.2	1.6
110	0.3	0.9	1.0
111	0.4	0.9	1.1

Note that the bases are empty almost 53% of the time and filled less than 2.5% of the time.

The above material has all been background, familiar to most people here, but it is useful to be sure everyone has the same orientation as to the nature of the basic data. What I did to extend this analysis was to examine transitions from one game state to the next and to calculate the changes in expected scoring. As noted above, this has been done by many and is usually categorized as a Markov approach, in honor of the Russian mathematician who first described this transitional analysis. This approach is the basis of the work by Mark Pankin and Tom Ruane I mentioned above.

As Mark Pankin commented to me earlier this summer, all Markov analyses have the fundamental assumption that the manner of reaching a situation does not change the consequences after that. The essence of my presentation today is to examine that assumption. I will do so by looking at several different transitions. There are two general types of question I will address and they are summarized in Figure 2 by specific examples.

Figure 2. Transitions to 1 out and runner on first

Type 1:

1 out, man on first may be reached two different ways:

a) 0 out, man on first to 1 out, man on first (0, 1 -> 1, 1)
b) 1 out, no one on to 1 out, man on first (1, 0) -> 1, 1)

Are these two paths equivalent?

Type 2:

0 out, man on first to 1 out, man on first.
Does the nature of the out matter?

Applying the expected runs tables to these questions gives the results in Table 4.

Table 4. Expected runs from different transitions to 1 out and runner on first.

Type 1:

Expected runs after all (1, 1) situations = 0.51

After (0, 1) -> (1, 1) = 0.51
After (1, 0) -> (1, 1) = 0.52

No apparent "path effect"

Type 2:

Expected runs after (0, 1) to (1, 1) via different outs

After ground ball or fly ball (includes popups and line drives) =	0.52
After strikeout =	0.50

Expected runs after (1, 0) to (1, 1) via different plays

After walk =	0.52
After hit by pitch =	0.56
After error =	0.50
After single =	0.52

Strikeouts slightly more negative and hit by pitch slightly more positive.

I then checked all possible transitions of increasing outs by one but leaving the baserunners the same (there are 15 of them). None of them had expected run differences more than .01, which would be a 1% effect. Interestingly, all 15 showed a more negative effect of strikeouts. Although they were all in the 1% range, the fact that strikeouts always had a greater impact is interesting. Perhaps these situations indicate that the pitcher is dominating (hence the strikeout) and the rest of the inning tends to go his way a bit more.

I refined the comparisons by dividing them in three different ways: by home vs road, by inning and by score differential. I had no predetermined idea that I would find differences, but these further divisions seemed like reasonable extensions to look for them. I decided to call them contexts. Let's revisit one of our basic transitions: 1 out, bases empty to 1 out man on first. The results are in Table 5.

Table 5. Expected runs after (1, 0) to (1, 1) in different contexts

(0.52 overall for this transition)

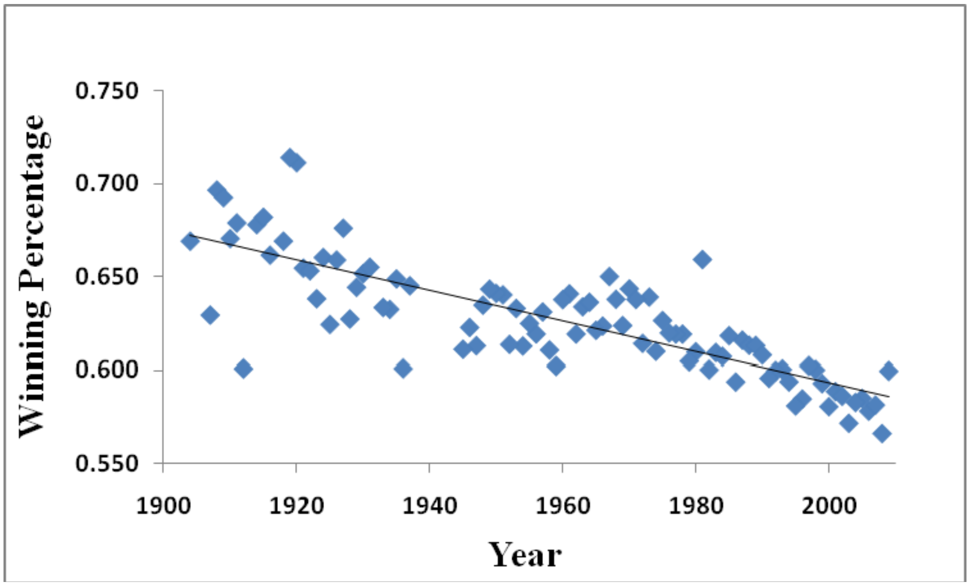
Batting team	
Visitor	.50
Home	.54
Inning	
1 to 3	.53
4 to 6	.53
7 to 9	.50
Extra innings omitted	
Score Differential	
< -3 (trail by more than 3	.51
> -3 and < 3	.52
> 3 (lead by more than 3)	.56

Each of the three contexts has its own interesting feature. The home team benefits by the same 2% that the visitor declines, giving a 4% difference. The early innings see a slight 1% increase in scoring, but the in the late innings, getting this runner on decreases scoring by 2%. The biggest difference is the variation found with a wide lead where the runner reaching base increases subsequent runs by 4%. There were almost 460,000 times this transition occurred in the data set so even changes of a few percent reflect a very large number of runs. The effects of batting team and inning match with my previous study (http://www.retrosheet.org/Research/SmithD/ScoringPattern.pdf) that shows higher scoring for the home team and declining scoring as the game proceeds. The large stimulation as a function of the score differential is more intriguing. Perhaps it is the case that teams which lead by a wide margin are simply having a good day so that every additional runner has a boosted chance of scoring.

To this point I have focused on transitions from one game state to another. There is another approach that may be useful as well and that is to simply count the number of baserunning outs and see if this total is related to the chance of a team winning the game. It seems reasonable to do this in two ways: on a per game basis and on a per season basis.

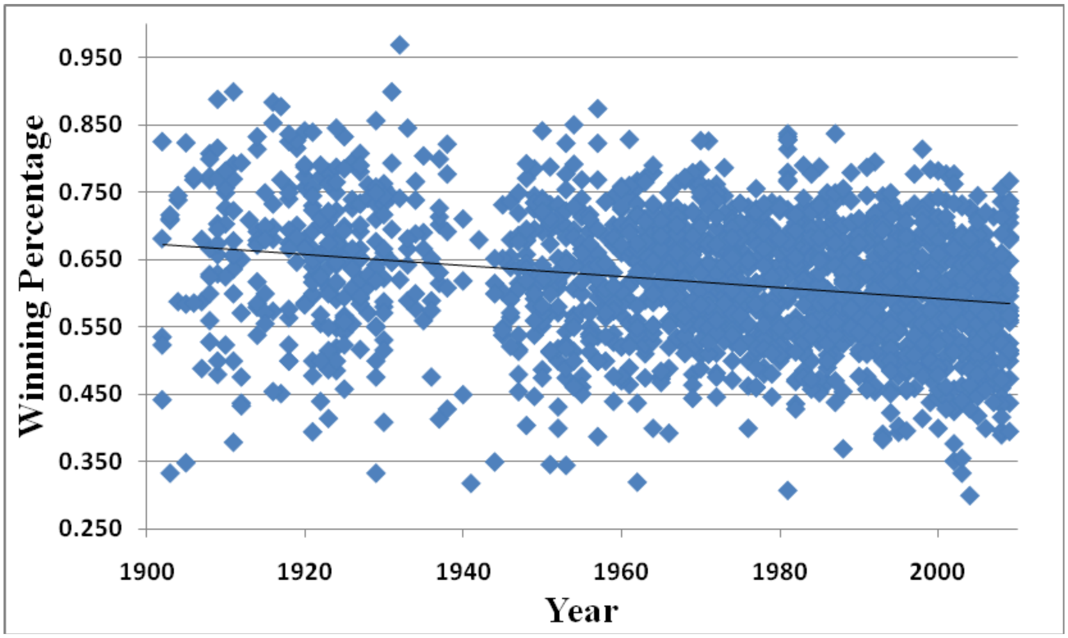
First let's look at individual seasons. I counted the number of baserunning outs in each game and eliminated all games in which the two teams had the same number of these plays. I then looked at the winning percentage of the teams with the greater number of baserunning outs. Figure 3 has the result, which may at first be a surprise.

Figure 3. Winning percentage of team with more baserunning outs, aggregated per season.



For all 109 seasons, the aggregate of teams with the larger number of these outs in each game had a higher winning percentage, with the lowest I found being .565 and the highest .711. The next obvious feature here is that there is a clear downward trend over the study period. If we characterize these baserunning outs as excessively aggressive running as opposed to merely aggressive, then it would appear that it was once more valuable than it is now, although it is still a positive feature. It is natural to ask if this pattern is observed when individual teams are examined and Figure 4 has the results for the approximately 2000 team-seasons, not aggregated by season.

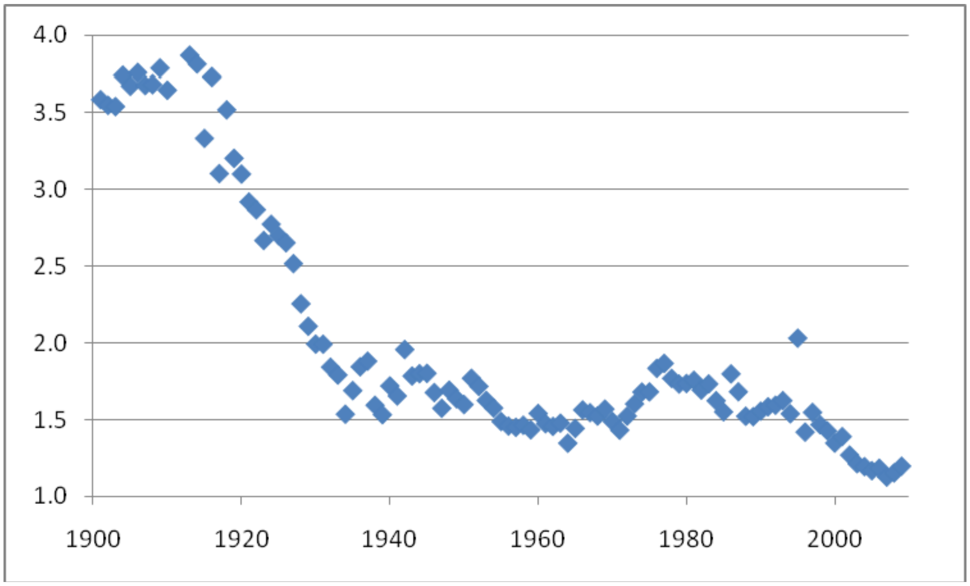
Figure 4. Winning percentage of team with more baserunning outs, each team presented separately.



There does not appear to be a strong pattern here, at least partly reflecting the loss of analytical power by subdividing the data this way.

I am sure that it will occur to most people here that the actual rate of these baserunning outs is unlikely to have been constant over all of these seasons and the data in Figure 5 show that this is indeed the case.

Figure 5. Baserunning outs per game, all teams aggregated by season



Here we see that in the deadball era there were nearly 4 baserunning outs per game and there was then a steep decline starting with the lively ball. It stabilized for a few decades and has been in another decline since the last expansion in 1997 so that the average now is just over one per game. There are many explanation for these patterns, but I favor the interpretation that these big changes in 1920 and 1997 reflect eras of increased offense and that teams became less willing to take the risk of having a baserunning out.

Conclusions

- Analysis of transitions shows very little effect from HOW an out is made, with the possible exception of strikeouts.
- This lack of effect is independent of home vs road, inning or score differential.
- Teams with more baserunning outs in a given game are much more likely to win, although the strength of this relation is only apparent on a whole season basis.

Remember that my title was a question: Are outs made on the bases more harmful than other types of outs? The answer would appear to be a qualified NO, although it is a bit more complicated than that.