BASEBALL ANALYST

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The December edition of the Baseball Analyst is running late, due to the editor's deadline for finishing the Baseball Abstract. Sorry about that; we should be back on schedule in February. The Analyst has several new subscribers this time, which makes it necessary to stop and re-state some of the operating assumptions. The new subscribers are the result of a mention in the SABR Bulletin; we appreciate the mention, although unfortunately the Bulletin had the price wrong. It is supposed to be $12.00 a year, so if any of you new people want to kick in an extra $2 for the year it would help keep the Analyst budget out of the red.

The assumptions. . .in subscribing to the Analyst, you are helping to support an idea. The Analyst runs 20 pages an issue (although this one is too long) and comes out only six times a year. So, for your twelve dollars, you get 120 pages of material, written by amatures, produced by kindergarten standards. This is not any heck of a bargain.

I have long felt that there should be a place for people who have an interest in sabermetrics to get to know one another, and to get to know one another's work. This is that place. I know that for many years I would start a research project, often put 20 or 30 hours into it, but finally get bogged down in some little technicality and just let the thing drop. Even if I finished it, so what? There was nothing to do with it, and thus no reason to write it up, no reason to rid it of its weaknesses, and no one to react to it. My work as an analyst of the game didn't begin to move forward until I got out of that shell, and found, in my correspondence with Dallas Adams, in my books and circle of readers, people that I could talk to about the subject. This magazine is an attempt to draw the other analysts of the game out of their shells, and form them into something of a community. This is the meeting place of sabermetrics.

I want that place to exist--but other people have got to want that place to exist, too. And that's how this thing is set up. If there are enough people out there who want it to go, it will go; if there aren't, it will fall. I am not going to carry. However many people subscribe, that will be the number of issues printed. There are no back issues. I am not going to subsidize the Analyst; I am not going to write it. If there aren't 20 pages of material ready for an issue, I will fold it rather than stretch what I have. Those are the rules; if you don't like them your $10 or $12 will be refunded. Because it is up to you. I have a place to write about baseball; this is your place.

And for that reason, the main thing that we need to have is articles. If you have a reaction to something that is written here, write it up. If you have a research project almost finished, finish it; if you have one in your files, get it out. This publication is not going to make it unless you do.

Articles should be typewritten, legible, ready to run; John Billheimer's article is a standard to shoot for. The articles should average about 3 to 4 pages and should never exceed 8. Some preference will be given to articles which respond to or advance earlier articles or comments, but strong preference will be given to articles which make sense by themselves, rather than those which require the reader to refer to something else to make sense of what is said.

And your work is appreciated; it really is. As new as this journal is, as primitive as a lot of it is, I have learned a lot from the articles in the first four issues, myself. I hope to learn a whole lot more in the future.

Bill James

MEASURING RELIEF PERFORMANCE

by John Billheimer

INTRODUCTION

The problem of measuring the performance of relief pitchers and comparing the relative value of starters, long relievers, and short relievers is a vexing one. The statistics traditionally attached to pitching performance (won/lost percentage, earned run average) aren't comparable among starters and relievers. In the case of the ERA, for example, starters are much more likely to give up clumps of runs before being yanked than relievers, who typically appear in the late innings of close games when a slight slip either ends the game or brings on another reliever. When a relief pitcher enters the game with runners on base and allows those runners to score, moreover, his ineffectiveness is not reflected in his earned run average. Rather, it raises the ERA of the pitcher who left the runners aboard. Late in the '81 season, for example, Tom Hume of Cincinnati relieved starter Mario Soto in the bottom of the eighth with two outs, runners on first and third and the Reds ahead 4 to 3. Hume walked the first hitter he faced to load the bases, and then gave up a single to Pete Rose which scored two runs. The starter, Soto, was charged with both runs and the eventual 5-4 loss. Hume's won/lost record was not affected, and no runs were registered against his ERA for 1/3 of an inning pitched.

The introduction of the SAVE has spotlighted the importance of relievers and provided an index for measuring the relative effectiveness of the short reliever whose job it is to protect a narrow lead in late innings. By itself, however, the SAVE is a somewhat unsatisfactory measure of performance. There is no way to gauge the number of opportunities a relief pitcher had to achieve a SAVE, or the number of times he failed to hold a late-inning lead. Moreover, SAVEs are not generally available to the long reliever who keeps his club in the game during the middle innings and may be just as important as the late-inning stopper, who is awarded the SAVE. By focusing attention on the late-inning stopper, the SAVE statistic has not only shaped the nation's image of the ideal relief pitcher, but may also, as Bill James has noted, have changed the way in which managers employ their best relievers. ("We only use Rollie Fingers when we're ahead" says Harvey Kuenn.)

DEFINITIONS

To provide a more accurate measure of the relative effectiveness of starters and relief pitchers, I have adapted and augmented two existing measures of pitching performance, the earned run average and the SAVE, in an attempt to minimize a few of the biases discussed above.

(1) In the case of the earned run average, the traditional ERA was modified by apportioning each earned run among the various pitchers responsible for the progress of that run toward home plate. A pitcher who allowed a runner to reach first and then departed, for

example, would be charged with only ¼ of an earned run if that runner eventually scored. Each subsequent pitcher would be assessed ¼ of a run for each base the runner attained during the pitcher's tenure on the mound. In the example given earlier, Soto, who turned the ball over to Hume with runners on first and third, would be charged with 3/4 of a run when the runner on third scored, and ¼ of a run when the runner on first scored, for a total of one run. Hume's earned run total would also be increased by one run (¼ run for the runner on third, and 3/4 run for the runner who moved to second on a walk and scored on Rose's single. The prorated earned run average (PERA) resulting from this sharing of responsibility should provide a more balanced indication of the relative effectiveness of starters and relievers than the traditional ERA.

(2) An attempt was made to augment the concept of the SAVE by acknowledging those times when a reliever entered the game with the winning run on base and failed to keep it from scoring. To do this, an anti-SAVE, or SLIP, was awarded whenever a reliever entered a game with runners on base, his team ahead or tied, and was on the mound (but not the losing pitcher) when the winning run scored. In the earlier example, Soto would still be the losing pitcher, but Hume would be awarded a SLIP for his ineffectiveness. To test the validity and utility of these two measures, the prorated ERA and the SLIP, I obtained information on the runs scored during each game of the strike-shortened 1981 season, and compiled statistics for each major league pitcher and team during that season.

TEAM STATISTICS

Tables 1 and 2 list the 1981 statistics on PERA, ERA, SAVEs, and SLIPs for every American and National League team during the 1981 season. PERA and ERA are compared for both starters and relievers, and the difference between the prorated ERA and the traditional ERA are tabulated for starters and relievers on each team. To no one's great surprise, the best relief staff in the American League on the basis of PERA belonged to the New York Yankees. Even through sharing the responsibility for jointly-allowed runs raised the ERA of the Yankee relief staff from 2.27 to 2.64, the adjusted value was well below that of any other American League Team. The lowest PERA in the National League in 1981 belonged to the Atlanta Braves' relief staff. The Braves' relief PERA of 2.93 was only .16 of a run higher than their traditionally calculated ERA, indicating that few runners on base when Braves' relievers were summoned went on to score. This capability of the Braves' relief staff in the clutch is further reflected by the fact that the relief staff was awarded no SLIPs at all in 1981. That is, no starting Braves' pitcher was ever charged with a loss because a runner he left on base scored during the tenure of a subsequent reliever.

The Cleveland Indians' 1981 relief squad had a harder time keeping runners from scoring than any other team's relievers. The PERA of the Indians' relievers was 4.9 runs per game, 0.83 runs per game higher than their traditionally calculated ERA. In the National League, the Cincinnati Reds' PERA of 4.62 runs per game was higher than that of any other team and 0.61 runs per game higher than their ERA.

Table 1

PRO-RATED EARNED RUN AVERAGES
STARTERS and RELIEF PITCHERS
AMERICAN LEAGUE TEAMS
1981 Season

TEAM	STARTERS					RELIEVERS							TOTALS	
	Innings		Earned Runs			Innings		Earned Runs			Saves/Slips			
	IP	(% of total)	PERA	ERA	(Difference)	IP	(% of total)	PERA	ERA	(Difference)	Saves	Slips	IP	(P)ERA
New York	666	70	3.01	3.16	-.15	282	30	2.64	2.27	.37	30	3	948	2.90
Oakland	824-2/3	83	3.05	3.17	-.12	168-1/3	17	4.52	3.95	.57	10	5	993	3.30
Texas	685-1/3	73	3.36	3.55	-.19	255	27	3.49	3.00	.49	18	2	940-1/3	3.40
Chicago	660-2/3	70	3.33	3.47	-.14	280	30	3.80	3.56	.24	23	6	940-2/3	3.47
Detroit	685-1/3	71	3.69	3.87	-.18	284	29	3.21	2.76	.45	22	6	969-1/3	3.53
Kansas City	678	74	3.59	3.82	-.23	244-1/3	26	3.47	2.84	.63	24	2	922-1/3	3.56
Baltimore	650-2/3	69	3.56	3.76	-.20	289-1/3	31	4.02	3.55	.47	23	3	940	3.70
California	651-1/3	67	3.74	3.95	-.21	320	33	3.64	3.21	.43	19	1	971-1/3	3.70
Boston	647-1/3	66	4.07	4.17	-.10	340	34	3.34	3.18	.16	24	5	987-1/3	3.81
Toronto	660-1/3	69	3.73	3.95	-.22	293	31	4.01	3.50	.51	18	9	953-1/3	3.82
Cleveland	713	77	3.56	3.81	-.25	218	23	4.91	4.08	.83	13	3	931	3.88
Milwaukee	648-1/3	66	3.94	3.84	-.10	337-2/3	34	3.84	3.46	.38	35	1	986	3.91
Minnesota	678-2/3	69	3.85	4.06	-.21	303	31	4.21	3.71	.50	22	6	979-2/3	3.98
Seattle	675-2/3	68	4.00	4.21	-.21	321-2/3	32	4.74	4.30	.44	23	7	997-1/3	4.23
TOTALS	9523-1/3	71	3.59	3.76	-.17	3936-1/3	29	3.82	3.37	.45	304	59	13459-2/3	3.66

Table 2

PRO-RATED EARNED RUN AVERAGES
STARTERS and RELIEF PITCHERS
NATIONAL LEAGUE TEAMS
1981 Season

TEAM	STARTERS					RELIEVERS							TOTALS	
	Innings		Earned Runs			Innings		Earned Runs			Saves/Slips			
	IP	(% of total)	PERA	ERA	(Difference)	IP	(% of total)	PERA	ERA	(Difference)	Saves	Slips	IP	(P)ERA
Houston	753	76	2.33	2.42	-.09	237	24	3.71	3.42	.29	25	3	990	2.66
Los Angeles	714	72	2.59	2.77	-.18	283	28	4.05	3.59	.46	24	5	997	3.01
San Francisco	662-1/3	66	3.32	3.47	-.15	347	34	3.21	2.93	.28	33	5	1009-1/3	3.28
Montreal	705-2/3	72	3.17	3.28	-.11	269-1/3	28	3.63	3.34	.29	23	2	975	3.30
Atlanta	639-2/3	66	3.72	3.80	-.08	328-1/3	34	2.93	2.77	.16	24	0	968	3.45
New York	560-1/3	60	3.67	3.83	-.16	366	40	3.36	3.12	.24	24	6	926-1/3	3.55
Pittsburgh	654-2/3	69	3.60	3.76	-.16	287-1/3	31	3.42	3.14	.28	29	4	942	3.56
St. Louis	612-1/3	65	3.32	3.58	-.26	330-2/3	35	4.20	3.73	.47	33	9	943	3.63
San Diego	643	64	3.90	4.04	-.14	359	36	3.40	3.16	.24	23	4	1002	3.73
Cincinnati	694-1/3	72	3.38	3.62	-.24	271-1/3	28	4.62	4.01	.61	20	4	965-2/3	3.73
Chicago	572-2/3	60	3.88	4.11	-.23	384	40	4.22	3.88	.34	20	3	956-2/3	4.01
Philadelphia	685	71	4.07	4.16	-.09	275-1/3	29	3.98	3.75	.23	23	3	960-1/3	4.05
TOTALS	7897	68	3.38	3.54	-.16	3738-1/3	32	3.71	3.39	.32	301	48	11635-1/3	3.49

Because a team's starting pitchers typically pitch far more innings than its relief pitchers, the PERA of most starters is relatively close to their traditionally calculated ERA. The average 1981 PERA of National League starters was 3.38, .16 runs lower than their ERA of 3.54. In the American League, starters posted PERAs of 3.59, .17 runs lower than their 3.76 ERA. In the case of relief pitchers, however, the differences between the PERA and the ERA are more substantial. In the American League, the PERA of the average relief squad was 3.82, .45 runs higher than their 3.37 ERA. The difference between PERA and ERA was somewhat smaller in the National League, where relief pitchers are more likely to enter games at the start of an inning. The calculated PERA for NL relievers was 3.21 runs per game, .31 runs higher than their 3.39 ERA.

While the ERA of the average reliever in both leagues was lower than that of the average starter, this situation is reversed when PERAs are compared. The difference between the 1981 PERAs of starters and relievers on individual teams was quite striking in several cases. Oakland A's relievers, for instance, had a combined PERA of 4.52, nearly 1.5 runs per game higher than the PERA of the starting pitchers. This suggests that Billy Martin was justified in relying heavily on his starters, who worked 83% of the team's innings, easily the highest percentage in the majors. The closest contenders were Cleveland, where starters worked 77% of all innings (and had a combined PERA 1.4 runs per game lower than the team's relievers), and Houston, where starters worked 76% of all innings (and allowed a major-league-leading PERA of 2.33 runs per game).

For the most part, those clubs whose relief staffs had siginificantly lower PERAs than the starting staffs (i.e., Atlanta, Boston, San Diego, and the New York Mets) tended to give their relievers a lot of work, so that the starters worked a relatively small percentage of the team's innings. The Cardinals proved a glaring exception to this rule. Whitey Herzog's starters worked only 65% of the teams innings in 1981 (fourth lowest in the majors) in spite of the fact that the PERA of the starting staff was nearly 0.9 runs per game lower than that of the relief corps.

In 1981, relief pitchers in the majors were awarded a total of 605 SAVES. By way of contrast, Tables 1 and 2 show that only 107 SLIPS were registered during the year. The SLIP, then, is a relatively rare event, occuring in only 7.7% of all major league games. In 1981, St. Louis and Toronto led the majors in SLIPS, each recording a total of nine.

INDIVIDUAL STATISTICS

Table 3 lists the top ten starters and relievers in each league, ranked in order of the prorated earned run average (PERA). The PERAs recorded by the league's top starters in 1981 were not much different from their ERAs, reflecting both the large number of innings pitched by these starters and the tendency of many managers to let their staff aces work themselves out of jams with men on base. In the case of individual relief pitchers, -- and particularly short relievers -- however, the PERA is markedly different from the ERA. Even with the inflation caused by the shared responsibility for runners on base when they enter the game, the best of the 1981 relievers ... Gossage, Fingers, Saucier, Sambito and Camp .... still have PERAs under 2.00 runs per game.

Several short relievers whose imposing SAVE totals annually generate reams of newsprint are conspicuously absent from the list of top-ten relievers ranked by PERA. The performance ratings of such familiar relief names as Doug Corbett, Kent Tekulve and Bruce Sutter all dropped appreciably when their ERAs were inflated to reflect the fate of runners left on base by other pitchers when they entered the game.

While lowering the ERAs of starters and inflating the ERAs of short relievers, the PERA also provides a more accurate picture of the relative worth of the long reliever who is called on to hold the opposition in the middle innings of a game. The long reliever may enter or leave a game with men on base, and hence the PERA measures his ability to keep inherited runners from scoring, while at the same time discounting somewhat (but not entirely) runs scored by baserunners left aboard for subsequent relievers. One of the best known of the game's middle relievers, Ron Davis, broke exactly even in this regard with the Yankees in 1981. Davis' ERA of 2.71 runs per game equalled his PERA. While his ERA ranked fourteenth among all relief pitchers, however, his PERA ranked seventh. The PERA of the Cub's middle relievers Lee Smith was 0.70 runs per game lower than his ERA of 3.49. While his ERA was twenty-fifth highest among NL relievers, his PERA ranked ninth from the top.

Table 4 lists those pitchers whose 1981 ERAs were affected most drastically by allocating the responsibility for "shared" runs between the leaving pitcher and the relieving pitcher. The biggest differences between the PERA and ERA were typically found among short relievers. The biggest difference in either league was registered by Doug Corbett, then with Minnesota. His inability to keep inherited runners from scoring caused his respectable 2.56 ERA to rise 1.07 runs per game to a PERA of 3.63 runs per game. A similar calculation caused the

Table 3

INDIVIDUAL 1981 PITCHING RECORDS
TOP TEN STARTERS and RELIEF PITCHERS
RANKED IN ORDER OF PRO-RATED EARNED RUN AVERAGE

STARTING PITCHERS
(100 or more innings)

AMERICAN LEAGUE

Rank	Pitcher, Club	IP	PERA	ERA	(Rank)	Diff
1	Lamp, Chi	127	2.18	2.41	(2)	-.23
2	McCatty, Oak	186	2.24	2.32	(1)	-.08
3	John, NY	140	2.50	2.64	(3)	-.14
4	Guidry, NY	127	2.60	2.76	(6)	-.16
5	Burns, Chi	157	2.60	2.64	(4)	-.04
6	Gura, KC	172	2.69	2.72	(5)	-.03
7	Leonard, KC	202	2.69	2.99	(9)	-.30
8	Wilcox, Det	166	2.81	3.04	(12)	-.23
9	Forsch, Cal	153	2.85	2.88	(7)	-.03
10	Blyleven, Cle	159	2.85	2.89	(8)	-.04

NATIONAL LEAGUE

Rank	Pitcher, Club	IP	PERA	ERA	(Rank)	Diff
1	Ryan, Hou	149	1.65	1.69	(1)	-.04
2	Reuss, LA	153	2.02	2.29	(4)	-.27
3	Knepper, Hou	157	2.18	2.18	(2)	0
4	Hooton, LA	142	2.21	2.28	(3)	-.07
5	Valenzuela, LA	192	2.33	2.48	(7)	-.15
6	Blue, SF	125	2.36	2.45	(6)	-.09
7	Carlton, Phil	190	2.42	2.42	(5)	0
8	Seaver, Cinn	166	2.45	2.55	(8)	-.10
9	Sutton, Hou	159	2.54	2.60	(9)	-.06
10	Niekro, Hou	166	2.59	2.82	(12)	-.23

RELIEF PITCHERS
(40 or more innings)

Rank	Pitcher, Club	IP	PERA	ERA	(Rank)	Diff
1	Gossage, NY	47	1.21	0.77	(1)	.44
2	Saucier, Det	49	1.62	1.65	(3)	-.03
3	Fingers, Mil	78	1.63	1.04	(2)	.59
4	Stewart, Bal	112	2.60	2.33	(6)	.27
5	Aase, Cal	65	2.63	2.35	(7)	.28
6	Quisenberry, KC	62	2.69	1.74	(4)	.95
7	Davis, NY	73	2.71	2.71	(14)	0
8	La Roche, NY	47	2.87	2.49	(9)	.38
9	Burgmeier, Bos	60	2.87	2.85	(16)	.02
10	Easterly, Mil	62	2.98	3.19	(18)	-.20

Rank	Pitcher, Club	IP	PERA	ERA	(Rank)	Diff
1	Sambito, Hou	64	1.83	1.81	(2)	.02
2	Camp, Atl	76	1.84	1.78	(1)	.06
3	Lucas, SD	90	2.13	2.00	(4)	.13
4	Fryman, Mont	43	2.21	1.88	(3)	.33
5	Holland, SF	101	2.35	2.41	(8)	-.06
6	Reardon, NY, Mon	70	2.46	2.19	(5)	.27
7	Howe, LA	54	2.61	2.50	(10)	.11
8	Falcone, NY	95	2.74	2.56	(14)	.18
9	Smith, Chi	67	2.79	3.49	(25)	-.70
10	Urrea, SD	49	2.80	2.39	(7)	.41

Table 4

INDIVIDUAL 1981 PITCHING RECORDS
RANKED IN ORDER OF PERA/ERA DIFFERENCE
(50 or more innings)

AMERICAN LEAGUE

	Pitcher, Club	IP	PERA	ERA	Diff
1	Corbett, Minn	88	3.63	2.56	1.07
2	Quisenberry, KC	62	2.69	1.74	.95
3	Jones, Oak	61	4.17	3.39	.78
4	Bird, NY	53	3.46	2.72	.74
5	Verhoeven, Minn	52	4.72	3.98	.74
6	Andersen, Sea	68	3.39	2.65	.74
7	Hassler, Cal	77	3.93	3.20	.73
8	Comer, Tex	72	3.28	2.57	.69
9	Hoyt, Chi	91	4.24	3.56	.68
10	Jackson, Tor	62	3.23	2.61	.62
	•				•
	•				•
	•				•
	Schatzeder, Det	71	5.71	6.08	-.37
	Clark, Sea	93	3.98	4.35	-.37
	Barker, Cle	154	3.53	3.92	-.39
	Flanagan, Bal	116	3.80	4.19	-.39
	Waits, Cle	126	4.48	4.93	-.46

NATIONAL LEAGUE

Pitcher, Club	IP	PERA	ERA	Diff
Kaat, St. Louis	53	4.34	3.40	.94
Capilla, Chi	51	4.01	3.18	.83
Tekulve, Pitt	65	3.29	2.49	.80
Moskau, Cinn	54	5.51	4.91	.60
Hume, Cinn	68	3.96	3.44	.52
Sutter, St. Louis	82	3.12	2.63	.49
Boone, SD	63	3.34	2.86	.48
Minton, SF	84	3.29	2.89	.40
Proly, Phil	63	4.21	3.86	.35
Reed, Phil	61	3.45	3.10	.35
•				•
•				•
•				•
Kravec, Chi	78	4.73	5.08	-.35
Lavelle, SF	66	3.43	3.82	-.39
Jones, Pitt	54	2.90	3.33	-.43
Griffin, Chi	52	4.01	4.50	-.49
Smith, Chi	67	2.79	3.49	-.70

Top Ten: Pitchers whose PERA was significantly higher than their ERA.
Bottom Five: Pitchers whose PERA was significantly lower than their ERA.

ERA of KC's Dan Quisenberry to rise nearly one run per game, from 1.74 to a still-respectable PERA of 2.69 runs per game. In the National League, the shared responsibility for inherited runners pushed the ERA of such noted relievers as Sutter, Tekulve, Minton, and Boone from under three runs per game to between 3.1 and 3.3 runs per game.

At the other end of the scale, the ERAs of several starting pitchers improved appreciably when the responsibility for runners who scored after they had left the mound was shared with relief pitchers. Among starters who put in more than 100 innings in 1981, Mike Flanagan of Baltimore and Len Barker and Rick Waits of Cleveland each had PERAs which were approximately .40 runs per lower than their official ERAs.

Although the SLIP was an intuitively attractive measure as an antidote for the SAVE, it proved in practice to be too rare an event, and too situation-dependent, to be very useful as an index of relief performance. The most SLIPS recorded by an individual reliever in 1981 was four. This dubious honor was shared by Doug Corbett of Minnesota and Greg Minton of San Francisco. As the relief stoppers on the Twins and Giants, respectively, however, Corbett and Minton were more likely to be called on when the game was on the line, and hence had proportionally more opportunities to slip. Minton's case provides a revealing footnote that emphasizes the difficulty of using traditional statistics to assess relief performances. All four of Minton's SLIPs came at the expense of teammate Al Holland. Four of Holland's five 1981 losses were recorded after he had turned the ball over to Minton.

CONCLUSION

Because the PERA apportions the responsibility for runners on base when a manager changes pitchers between the incoming and outgoing pitcher, this statistic provides a common base for comparing all pitchers, whether they are starters, long relievers, or short relievers. It uses a familiar measure, earned runs per nine innings, and a comparison of individual PERAs and ERAs, particularly those of short relievers, highlights one of the key shortcomings in the traditionally-computed ERA. The difficulty with the measure is a practical one - it cannot be readily calculated from the information contained in the traditional box score. Whereas the PERA proved to be a useful measure of individual and squad performance, the SLIP, conceived as an antidote for the SAVE, proved to be too rare an event, and too situation-dependent, to be very useful as an index of relief performance.

SOME ADDITIONAL ASPECTS OF THE DISTRIBUTION OF RUNS SCORED

by Dallas Adams

Section I - Run Distributions Updated Through 1981

Issue number 1 of The Baseball Analyst included a study, "The Distribution Of Runs Scored", which I wrote a few years ago. This work determined the probability with which a team, based on its season average runs per game, could be expected to score any exact number of runs in a game. The approach was empirical and utilized major league game scores from 1967 through 1976.

From that starting point there were several side areas which I have long wanted to investigate; and that recent publication of my paper has supplied the impetus. The first task, I felt, was to update the earlier work to include the seasons 1977-1981. This latter block of seasons is richer in high scoring teams than was the 1967-1976 period; and to include them will enhance the reliability of the data. There were, for example, more teams averaging better than 4.5 runs per game in the five years since 1976 than there were in the preceding ten years.

I followed the same procedure as before: grouping together teams which showed similar runs per game averages and then tabulating scores game by game for the teams in each group. There are 11 groups and Table-1 shows the characteristics for each.

Table-2 presents the percentage of games, for each group individually, in which each specific number of runs are scored. The regularity of the data in this table allows the determination of empirical equations expressing the probabilities as a function of team average runs per game (R/G). If N is the number of runs and P_N is the probability of scoring exactly N runs in a game, then:

(1) For N=4 runs or fewer, for R/G less than 4.25; or N=5 runs or fewer, for R/G = 4.25 or more

$$P_N = AN^2 + BN + C \qquad \text{(equation 1)}$$

where
$$A = .0000770825(R/G)^2 + .00390782(R/G) - .0275768$$
$$B = -.0071265(R/G)^2 + .0518252(R/G) - .034879$$
$$C = .0145462(R/G)^2 - .160702(R/G) + .483692$$

(2) For N=5 runs or more, for R/G less than 4.25; or N=6 runs or more, for R/G = 4.25 or more

$$P_N = DE^N \qquad \text{(equation 2)}$$

where
$$D = -.0586499(R/G)^2 + .46816(R/G) + .00884832$$
$$E = .000908818(R/G)^2 + .0345158(R/G) + .51677$$

In the future I hope to be able to replace the above equations with a single, compact, continuous equation. I've done a fair amount of work in this direction but with no worthwhile results as yet.

TABLE - 1

GROUP CHARACTERISTICS

GROUP NUMBER	RANGE OF AVERAGE RUNS PER GAME	NUMBER OF TEAMS IN THE GROUP	GROUP AVERAGE RUNS PER GAME
1	2.75 - 2.99	6	2.912
2	3.00 - 3.24	15	3.141
3	3.25 - 3.49	28	3.373
4	3.50 - 3.74	40	3.620
5	3.75 - 3.99	72	3.856
6	4.00 - 4.24	62	4.114
7	4.25 - 4.49	57	4.353
8	4.50 - 4.74	43	4.601
9	4.75 - 4.99	23	4.889
10	5.00 - 5.24	10	5.113
11	5.25 - 5.49	6	5.306

TABLE - 2

THE PERCENTAGE OF GAMES IN WHICH EXACTLY THE GIVEN NUMBER OF RUNS ARE SCORED

EXACT RUNS	GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5	GROUP 6	GROUP 7	GROUP 8	GROUP 9	GROUP 10	GROU 11
0	14.52	11.96	10.12	9.50	8.08	7.19	6.24	5.37	4.48	4.07	4.86
1	18.91	16.85	15.28	13.49	12.64	11.63	10.58	9.82	8.16	8.09	7.33
2	17.03	17.83	17.71	16.52	14.73	14.45	13.46	12.38	10.72	9.57	10.74
3	16.41	16.09	16.47	15.51	16.03	15.11	14.37	14.06	14.43	13.15	11.16
4	10.97	12.34	12.87	12.73	13.49	13.90	13.46	13.10	13.61	11.60	12.81
5	9.09	8.72	9.07	10.73	11.15	11.58	11.29	11.70	12.20	13.64	11.26
6	5.02	5.79	5.93	7.75	7.93	6.58	9.22	9.57	9.95	10.62	8.68
7	2.72	4.85	5.02	4.83	5.76	6.55	6.96	7.82	7.50	7.96	8.99
8	1.78	2.17	3.39	3.79	3.75	4.38	5.10	5.43	6.02	7.35	6.30
9	1.36	1.62	1.68	2.15	2.62	3.19	3.35	3.36	4.29	4.44	5.89
10	1.25	0.81	0.96	1.20	1.57	2.27	2.13	2.40	3.22	3.09	3.62
11	0.31	0.51	0.82	0.80	0.82	1.21	1.35	1.79	1.73	2.65	3.20
12	0.31	0.21	0.30	0.44	0.58	0.72	1.11	1.45	1.18	1.23	1.65
13	0.21	0.17	0.19	0.21	0.30	0.50	0.56	0.61	0.91	0.93	1.45
14	0.00	0.00	0.09	0.17	0.22	0.24	0.30	0.53	0.77	0.49	0.93
15	0.00	0.04	0.07	0.05	0.13	0.21	0.21	0.21	0.30	0.49	0.21
16	0.10	0.04	0.02	0.03	0.11	0.07	0.10	0.24	0.14	0.31	0.31
17	0.00	0.00	0.00	0.02	0.04	0.12	0.06	0.09	0.14	0.00	0.21
18	0.00	0.00	0.00	0.05	0.01	0.04	0.04	0.06	0.14	0.25	0.10
19+	0.00	0.00	0.00	0.05	0.05	0.07	0.10	0.04	0.11	0.06	0.[illegible]

Section II - Run Distributions By Innings And Outs

In the preceding section, equations were developed to express the probability of scoring exactly a specified number of runs in a game. The logical follow-up is to determine the same sort of probabilities on an inning basis and even on an out basis. The difficulty is that the distribution of runs in a game is not Poisson or Binomial or some other well defined mathematical form from which the distribution of runs in an inning could be easily extracted. I was unable to proceed until Dr. G. Wanner of the University of Geneva devised a recursive technique to handle the problem.

Let us assume, Dr. Wanner said, that the number of runs in different innings is independent of each other. Then, if we know the probabilities P_N for scoring exactly N runs in a full game, we can determine the probabilities Q_N of scoring exactly N runs in a half game (this is not the interval we are interested in, but it will serve well as an example since the equations are simpler) since the following formulas must hold:

$P_0 = Q_0Q_0$ (no score in the full game means no score in either half)

$P_1 = Q_1Q_0 + Q_0Q_1$ (one run in the full game means either one run in the first half and none in the second, or conversely)

$P_2 = Q_2Q_0 + Q_1Q_1 + Q_0Q_2$ (two runs in the game means one of three possibilities: two runs in the first half and none in the second, or conversely, or one run in each half)

etc.

From these formulas the probabilites $Q_0, Q_1, Q_2, \ldots$ can be determined recursively. From the first formula we get $Q_0 = \sqrt{P_0}$. Then, from the second formula, $Q_1 = P_1/(2Q_0)$. From the third formula, $Q_2 = (P_2 - Q_1{}^2)/(2Q_0)$, and so on.

We can then repeat the process with the new probabilities Q_N to obtain the probabilities R_N of scoring exactly N runs in one fourth of a game. That is,

$Q_0 = R_0R_0$

$Q_1 = R_1R_0 + R_0R_1$

etc.

And yet another repetition would give the probabilities for one eighth of a game.

Our interest lies not in the probabilities for one half, one fourth, one eighth, etc of a game but rather in the probabilities for one third, one ninth (i.e. one inning) and one twentyseventh (i.e. one out). For these the same procedure can be applied, although the equations are more complicated.

Begin by considering thirds of a game; let Q_N be the probability of scoring exactly N runs in one third of a game:

$P_0 = Q_0Q_0Q_0$ (eqn 3) (no score in the full game means no score in any of the three thirds)

$$P_1 = Q_1Q_0Q_0 + Q_0Q_1Q_0 + Q_0Q_0Q_1 = 3Q_1Q_0^2 \qquad \text{(equation 4)}$$

$$P_2 = Q_2Q_0Q_0 + Q_0Q_2Q_0 + Q_0Q_0Q_2 + Q_1Q_1Q_0 + Q_1Q_0Q_1 + Q_0Q_1Q_1$$

$$= 3Q_2Q_0^2 + 3Q_0Q_1^2$$

etc., which leads to the general equation

$$P_N = \sum_{k=0}^{N} \sum_{j=0}^{N-k} Q_kQ_jQ_{n-k-j} \qquad \text{(equation 5)}$$

To solve, obtain from equation 3: $Q_0 = \sqrt[3]{P_0}$ (eqn. 6)

and from equation 4: $Q_1 = P_1/(3Q_0^2)$ (eqn. 7)

and finally, from equation 5, for N=2, 3, 4, ...

$$Q_N = \frac{P_N - \sum_{k=1}^{N-1} \sum_{j=0}^{N-k} Q_kQ_jQ_{N-k-j} - Q_0 \sum_{j=1}^{N-1} Q_jQ_{N-j}}{3Q_0^2} \qquad \text{(eqn. 8)}$$

These Q_N's give the probability of scoring exactly N runs in a three inning period. Repeat the procedure (letting $Q_0 = R_0R_0R_0$, $Q_1 = 3R_1R_0^2$, etc) to find the probabilities of scoring exactly N runs in a one inning period. A final repetition will give the probabilities for scoring exactly N runs in a one out period. Table-3 shows these run scoring probabilities for intervals of a full game, one inning and one out.

TABLE-3

RUNS	PROBABILITIES PER GAME	PER INNING	PER OUT
0	0.0624000	0.7347370	0.9023550
1	0.1058000	0.1384170	0.0566647
2	0.1346000	0.0717903	0.0258310
3	0.1437000	0.0339544	0.0105815
4	0.1346000	0.0125666	0.0029742
5	0.1129000	0.0021615	-0.0001827
6	0.0922000	0.0071200	0.0025865
7	0.0696000	-0.0007204	-0.0007055
8	0.0510000	0.0009925	0.0003214
9	0.0335000	-0.0031403	-0.0013542
10	0.0213000	0.0006451	0.0004101
11	0.0135000	0.0013246	0.0005694
12	0.0111000	0.0034398	0.0013376
13	0.0056000	-0.0048201	-0.0021718
14	0.0030000	0.0004613	0.0003592
15	0.0021000	0.0016261	0.0007205
16	0.0010000	-0.0006447	-0.0003341
17	0.0006000	0.0001334	0.0000592
18	0.0004000	-0.0003592	-0.0001649
19	0.0010000	0.0013815	0.0006003

O.K., there is more to Dallas' article--9 pages more--but we'll let him finish it next issue. It's going to take me at least two months to figure out what he is talking about here, anyway, if indeed I am able to figure it out at all.

For the 1983 Baseball Abstract, I made a count of how many times each American League team scored exactly one, two . . . however many runs in one inning. I did this in order to provide a basis for study of the impact of what I call first-run strategies on run production; for example, to know how Gene Mauch's love of bunting affects the run production of his team, it is useful to know exactly how many big innings his team has, and how many one-run innings. Very clear patterns emerge in this data; there is a clear natural division between big-inning teams and others.

More on all that in the Abstract; what I wanted to do here is compare Dallas' theoretical chart of how often a team scoring 4.353 runs per game should score X runs in an inning with the actual innings breakdowns of the two AL teams which were closest to that Run Per Game average. Those two teams were New York (4.377 runs per game), and Oakland (4.265). The Yankees were a big inning team; Oakland was not:

Frequency of X Runs In An Inning

X =	0	1	2	3	4	5	6	7	8 or more
Theoretical	.735	.138	.072	.034	.013	.002	.007	-.0007	.001
New York	.731	.152	.058	.034	.014	.008	.003	.0007	0
Oakland	.722	.159	.072	.027	.012	.008	.0007	0	0

So it looks like the theory, difficult as it is, is reasonably on target. I would say with respect to the problem of negative results in the very-large inning classes that it was more likely due to over-extrapolation from small data, rather than interdependence of innings. Bill James

A NEW LOOK AT "HARD LUCK" PITCHERS

Mark Lazarus

As a fledgling sabermetrician, I have been inspired to great heights by Bill James' Baseball Abstract. After reading the '82 version, I blasted my way through the '82 boxscores. My quest was for the answer to the age-old question, "Do certain pitchers get better defensive support than others?" James examined one aspect of this with his DP per start, but another attainable stat is errors committed behind each pitcher, and where they were committed. Of course, the second question is, "Why does this occur?". In this essay, I am only offering definite answers to the first question, and theories on the second. Hopefully, in the sprit of this publication, this study can serve as a building block for more extensive analysis. I hope to go back to at least 1975 to finally answer my ex-roommate's contention that the Phillies made more errors behind Jim Lonborg than anyone else. (He was a Red Sox fan, who, in '75, still loved Lonborg--but hated skiing!)

Through this study, we may be able to develop a greater understanding for many questions, including:

1. Does a slow working pitcher affect the concentration of his fielders, resulting in more errors? We can compare errors behind (EB) to average game time. Also, the number of pitches to each batter can affect concentration. Probably the best way to approximate that is to total walks and strikeouts.

2. Do control-type sinkerball pitchers have more infield errors behind them, or does the fact that they usually throw less pitches enhance the concentration of his fielders? (Craig Wright's comparison between Tommy John (15% unearned runs) and Ron Guidry (10% unearned) would suggest that sinkerballers do have more e's.)

3. Does the rotation of a pitch have anything to do with errors? I have provided a breakdown of errors behind lefties and righties.

4. Do knuckleball pithcers really have more passed balls committed while pitching? I have researched PB for each pitcher.

The questions can go on and on...But let's go on to the heart of the study...the stats!

As in BJ's studies, I am forced by the sources available to give this data only for starting pitchers, while only leaving out errors committed by relief pitchers. The final errors committed behind per game started (EB/GS) figure includes the errors committed by the pitchers themselves, as to coincide with BJ's DP/GS.

INDIVIDUAL ANALYSIS:

Below is a chart listing the individual Top and Bottom Ten in each league. As one can see, the differences are startling!

TOP AND BOTTOM TEN

NATIONAL LEAGUE

BEST Pitcher, team	EB/GS	WORST Pitcher, team	EB/GS
1. J. Niekro, Hou	.46	1. M. Scott, NY	1.27
2. Mura, StL	.53	2. Welsh, SD	1.25
3. Christensen, Phi	.55	3. Zachry, NY	1.25
4. Pastore, Cin	.55	4. R. Martin, SF	1.20
5. Gullickson, Mon	.56	5. Bystrom, Phi	1.19
6. LaPoint, StL	.57	6. Gale, SF	1.17
7. Lollar, SD	.59	7. Ruhle, Hou	1.14
8. Carlton, Phi	.61	8. Burris, Mon	1.07
9. Mahler, Atl	.61	9. Sarmiento, Pit	1.06
10. Camp, Atl	.62	10. Reuss, LA	1.05

AMERICAN LEAGUE

BEST Pitcher, team	EB/GS	WORST Pitcher, team	EB/GS
1. Kison, Cal	.375	1. Trout, Chi	1.47
2. Morris, Det	.378	2. Norris, Oak	1.36
3. Koosman, Chi	.47	3. Lerch, Mil	1.25
4. Nelson, Sea	.47	4. Hoyt, Chi	1.06
5. Palmer, Bal	.50	5. Hurst, Bos	1.00
6. Flanagan, Bal	.51	6. Burns, Chi	1.00
7. D. Martinez, Bal	.51	7. McCatty, Oak	1.00
8. Denny, Cle	.52	8. Moore, Sea	1.00
9. Haas, Mil	.52	9. M. Morgan, NY	.96
10. O'Connor, Min	.53	10. Wilcox, Det	.93

Note that four NL teams have pitchers in BOTH the Top and Bottom Ten, proving that errors are not distributed evenly. Also note the huge disparity between Steve Trout (1.47) and Jerry Koosman (0.47) both of the Chisox. Using these pitchers to test the concentration theory, Trout should pitch longer games with more strikeouts and walks. Average time of game--using the '81 stats--Trout 2:42, Koosman 2:26. In '82, Trout had .42 walks/inning and .52 strikeouts/inning (.94 total), compared to Koosman's .22walks/inn and .51 strikeouts/inn (.73 total). I am sure one could find many examples to disprove this theory, but that would spoil my fun!

Seriously, some of the interesting oddities from examining the breakdown by position behind each pitcher are:

-Bill Gullickson- NO errors at 2B or SS in 34 starts! The only starter in the majors even close to that!

-Rick Camp- NO errors at 1B or 3B in 21 starts!

-Rick Rhoden- 9 Catcher errors! His OSB must be outrageous. As a general rule, pitchers who get run on alot will have more catcher errors. An exception to this is Dick Ruthven of the Phillies. His release time from the stretch is so slow that Diaz doesn't bother to throw half the time. Mike Schmidt's quote last month, "Walks are like doubles against us" is a direct reference to Ruthven. Combine that with his refusal to change his motion and you can book that Rufus will be traded before Opening Day '83! Oh yeah--Rich Gale was second with 8, and Marty Bystrom had 6 in 16 starts (2nd stringer Ossie Virgil, Jr. caught him).

-Joe Niekro- 21 PB! Second was Charlie Hough with 15. The highest non-knucklers were Dave Righetti and Rick Rhoden, each with 6. Phil Niekro only had 7 which must mean that Bruce Benedict is a helluva catcher! And what does that tell us about Alan Ashby? Well, Houston had Luis Pujols catch J. Niekro most of the time, and he committed 20PB!!

That brings up another category--pitchers and fielders NOT to invite to the same party...

-Rick Mahler and Raphael Ramirez- 12 errors at SS!
-Bill Russell & the LA pitching staff! (35 at SS)
-Chris Welsh and Garry Templeton- 8 at SS in 20 GS.
-LaMarr Hoyt and Ron LeFlore- 7 in CF! (I wouldn't invite Leflore to ANY party!)
-Bruce Hurst and Carney Lansford- 8 at 3B in only 19 GS (Yet, Lansford made NONE behind another Bosox lefty, John Tudor)
-Finally, Gaylord Perry and Todd Cruz- 11 at SS--the ball somehow gets slick on the way out to SS!!

OVERALL ANALYSIS:

The overall NL average EB/GS was .08 higher than the AL(NL-.83, AL-.75). Is this significant? It represents only about a 12 error difference over 162 games, and the stats are only for one season, but may still be meaningful. The difference could be due to the DH. For the most part, AL teams will pull their worst fielder off the field as the DH (although the Chisox had a difficult decision with EL Pigo, LeFlore, Kemp, etc.). Take Kingman, Oliver, Bench, R. Smith, et al, off the field and the leagues are almost exactly even!

One factor often overlooked is the effect of a bad fielding first baseman on the rest of the infield. The Mets committed 94 errors at 2B, 3B, and SS, compared to 52 for the Cardinals. By no means am I comparing Gardenhire, Brooks, and whomever to Ozzie, Oberkfell and Herr, but how many of those 94 errors would have been prevented by Gold Glover Hernandez? Checking back over Larry Bowa's record, from '70 to '79, was over 13 errors only twice (25+17)-the years Dick Allen played 1B.

Here are the EB/GS by position for each league:

	NL	AL	COMMENT
PB	.0802	.0700	
C	.0988	.0692	More stealing in NL
P	.0633	.0511	More errant pickoffs because of above
1B	.0823	.0793	
2B	.1178	.0969	
3B	.1425	.1427	
SS	.1718	.1727	
LF	.0561	.0414	Many real DM's play LF in NL (Foster,Smith..
CF	.0448	.0432	
RF	.0417	.0454	

There is almost no difference at SS and 3B! This kind of stat will be more meaningful after I do more research on past years.

Amazingly enough, in the NL, the EB/GS for BOTH LHP AND RHP , <u>not</u> including pitcher errors, is .76. The difference in the AL is only .06 and overall is .03. RHP tend to make more errors, probably because of the tougher pickoff throw to first. The following chart breaks it down by position (% listed equals the % <u>more errors</u> per game behind LHP or RHP):

	NL	AL
PB	30.2 R	6.4 R
C	31.3 R	6.1 L
P	42.2 R	6.9 R
1B	10.5 R	15.9 R
2B	3.3 L	0.8 R
3B	14.5 L	21.7 L
SS	18.3 L	23.3 L
LF	33.1 R	20.2 L
CF	6.8 L	17.0 L
RF	8.7 R	19.9 R

The only big discrepencies are at catcher and in LF. Again, based on one season, definite conclusions are tough, but, it seems more infield errors and in CF are made behind LHP. Why? It could be that there are proportionately more junk-balling lefties who don't strike out as many as righties. A follow up to this could be a breakdown of strikeoouts per 9 innings for LHP + RHP.

TEAM ANALYSIS:

Next year I am going to give breakdowns for artificial turf and grass. The top 4 teams in the NL were all on polypropylene, and the bottom 3 were all on grass.(Or should I say "played on 'Natural Turf'") But in the AL, Kansas City, Toronto, and Seattle were 10th through 12th. So, it could be that mediocre defense doesn't improve on rugs. We'll know more next year!

Because of space limitations, I cannot give all of the stats for all of the teams. However, I can point out some strange things---

--ZERO errors in LF for California.
--ONE error in CF for KC (behind Splittorf)
--EIGHTEEN (That's right- 18!) errors in CF for the White Sox! In fact, if defense up the middle is the key to winning, the Chisox were in a heap of trouble! It's amazing that they won as often as they did! The South-Siders had 21 at 2B, 42 at SS, and 18 in CF--81 errors at those key positions! The gazelles in Flushing Meadows, NY had "only" 66. Detroit was the best with just 31.
(Note: Tony Bernazard did lead the majors in Range Factor at 2B with 5.8, so the Sox "D" was not as bad as the errors alone would indicate.)
--FOURTEEN in CF and TEN in LF for St. Louis--and that's not counting how many times Lonnie fell down!
--Only SEVEN errors at 2B for Trillo and Philly--second was Morgan and SF at 14!

Philadelphia and St. Louis tied for the NL team lead at .72 EB/GS. (Remember, this does not include relief pitchers' errors) The Mets gave new meaning to the term "slick fielding" by being the only team in the majors over one at 1.04. SF was next to last at .96.

Baltimore led the AL at .59--in fact, six AL teams surpassed the Phils and Cards--Baltimore, California (.64), Minnesota (.65), Detroit (.68), Boston (.69), and Texas (.70). Oakland was the worst in the AL at .96 with Chicago challenging at .94.

In summary, I feel that this is a good beginning for the study of how a pitcher can affect his teammates' fielding. We certainly have many questions to explore and dissect and much work to do. Personally, although I have done small scale statistical studies before, my first big plunge into Sabermetrics has been great. My wife and friends think I'm crazy, so I've passed the first big test! Now--back to work! Hmm....I wonder if the Phils really did make more errors behind Lonborg....

THOUGHTS ON ISOLATED POWER

Jim Reuter

Isolated power (slugging percentage minus batting average) is considered by many to be the proper measure of a ballplayers power hitting abilities. Slugging percentage is rightly discounted as a true power statistic because exceptional singles hitters can accrue high percentages. Slugging percentage divided by batting average should also be discounted, both because it penalizes a player for hitting a single and because it fails to describe the frequency of the batters success at the plate.

It should be pointed out that isolated power also suffers the problem of decreasing when a batter hits a single. This is easily shown:

$$IP = SP - BA = \frac{S+2D+3T+4HR}{AB} - \frac{S+D+T+HR}{AB} = \frac{D+2T+3HR}{AB} = \frac{EB}{AB}$$

where IP-isolated power; SP-slugging percentage; BA-batting average; S-singles; D-doubles; T-triples; HR-homeruns; AB-at bats; EB-number of extra bases.

Thus, every single increases the denominator of the isolated power equation but leaves the numerator unaffected. This problem can be corrected quite simply:

$$\text{Adjusted Isolated Power (AIP)} = \frac{D+2T+3HR}{AB-Hits} = \frac{SP-BA}{1-BA}$$

Adjusted isolated power means literally the number of extra bases the batter attains per out expended. It increases proportionately for each extra base attained, decreases for each out made, and remains unchanged for a single or a walk. Isolated power has the same characteristics except it decreases when a single is hit. Adjusted isolated power does lack the convenience of isolated power, which is calculated on the same per official at bat basis as the other major batting statistics.

The lifetime adjusted isolated power leaders are listed in Table 1. The top ten adjusted isolated power leaders for four twenty year time periods are also included.

Table 1.
Lifetime Adjusted Isolated Power Leaders (minimum 4000 at bats)

	Player	rank: AIP(IP,SP)		Player	rank: AIP(IP,SP)
1.	Babe Ruth	.528(1,1)	11.	Johnny Mize	.363(13,8)
2.	Lou Gehrig	.443(2,3)	12.	Hank Aaron	.359(14,12)
3.	Ted Williams	.441(4,2)	13.	Willie Stargell	.347(15,25)
4.	Hank Greenberg	.425(3,5)	14.	Duke Snider	.347(17,16)
5.	Jimmie Foxx	.421(5,4)	15.	Frank Robinson	.344(18,17)
6.	Joe DiMaggio	.376(11,6)	16.	Hack Wilson	.343(22,14)
7.	Ralph Kiner	.373(7,13)	17.	Dave Kingman	.342(8,-)
8.	Mickey Mantle	.369(9,11)	18.	Richie Allen	.341(19,21)
9.	Mike Schmidt	.368(6,19)	19.	Stan Musial	.341(26,9)
10.	Willie Mays	.366(10,10)	20.	Rogers Hornsby	.340(38,7)

Adjusted Isolated Power Leaders for Four Twenty Year Periods
(minimum 4000 AB)

1901-1920

	Player	AIP(rank)
1.	Gavvy Cravath*	.268 (-)
2.	Joe Jackson	.251 (-)
3.	Buck Freeman	.238 (-)
4.	Tris Speaker	.237 (-)
5.	Ty Cobb	.231 (-)
6.	Honus Wagner	.208 (-)
7.	Sam Crawford	.207 (-)
8.	Tilly Walker	.203 (-)
9.	Zack Wheat	.195 (-)
10.	Elmer Flick	.195 (-)

1921-1940

	Player	AIP(rank)
1.	Babe Ruth	.528 (1)
2.	Lou Gehrig	.443 (2)
3.	Hank Greenberg	.425 (4)
4.	Jimmie Foxx	.421 (5)
5.	Hack Wilson	.343 (16)
6.	Rogers Hornsby	.340 (20)
7.	Mel Ott	.329 (24)
8.	Chuck Klein	.328 (26)
9.	Wally Berger	.316 (28)
10.	Earl Averill	.316 (29)

1941-1960

	Player	AIP(rank)
1.	Ted Williams	.441 (3)
2.	Joe DiMaggio	.376 (6)
3.	Ralph Kiner	.373 (7)
4.	Mickey Mantle	.369 (8)
5.	Johnny Mize	.363 (11)
6.	Duke Snider	.347 (14)
7.	Stan Musial	.341 (19)
8.	Eddie Mathews	.327 (27)
9.	Hank Sauer	.313 (32)
10.	Roy Campanella	.309 (36)

1961-1980

	Player	AIP(rank)
1.	Mike Schmidt	.368 (9)
2.	Willie Mays	.366 (10)
3.	Hank Aaron	.359 (12)
4.	Willie Stargell	.347 (13)
5.	Frank Robinson	.344 (15)
6.	Dave Kingman	.342 (17)
7.	Richie Allen	.341 (18)
8.	Harmon Killebrew	.339 (21)
9.	Willie McCovey	.335 (22)
10.	Jim Rice	.329 (23)
11.	Reggie Jackson	.328 (25)
12.	George Foster	.316 (30)

*Gavvy Cravath had only 3950 official at bats.

Players were placed in the time period in which they had the most at bats. Their overall adjusted power rank is included if they are in the top 40. Active players statistics were calculated through the 1980 season.

GENERAL COMMENTS... OR A LETTER TO THE EDITOR?

I would like to make a request based on the article "More On the Stolen Base Question" in the 1981 Baseball Abstract. This article, written by Dallas Adams, utilizes a study performed by Pete Palmer in which the probability of the home team going on to win a game is found, based on the game situation. I would be quite interested in seeing the results of Palmer's study in the Analyst.