

# Percentage of Extra-Base Hits

A new indicator of power

BASEBALL RESEARCH  
JOURNAL (SABR)

No 26, 1997

Mary Ashworth, Gabriel Costa, Dale Edmiston,  
William Fox, Michael Huber, Jonathan Roginski,  
and Emett White

Much attention is given to the sluggers of the game: Babe Ruth and Lou Gehrig; Jimmie Foxx and Mel Ott; Frank Robinson and Hank Aaron; Willie Mays and Mickey Mantle; Reggie Jackson and Mike Schmidt; Frank Thomas and Ken Griffey, Jr. Fans become obsessed with how many home runs a favorite player has hit. When a player hits eleven round-trippers in the month of April, as Brady Anderson of the Baltimore Orioles did to start the 1996 season, fans excitedly contemplate whether he will break Roger Maris's record of 61 in a season. What about the other base hits? How does the percentage of extra-base hits describe a player's power? In 1995, Albert Belle hit 50 home runs, 1 triple, 52 doubles, and 70 singles, for a total of 173 hits. More important, he totaled 103 extra-base hits. And, he accomplished the feat in only 143 games! His percentage of extra-base hits for 1995 was 0.5954, the highest individual percentage in history.

The percentage of extra-base hits (PXBH) is defined as a player's number of extra-base hits (XBH) divided by his total number of hits (H), or

$$\text{PXBH} = \frac{\text{XBH}}{H} = \frac{\text{HR} + 3\text{B} + 2\text{B}}{H}$$

In contrast, a player's slugging percentage (SLG) is defined as his total bases (TB) divided by his total at-bats (AB),

$$\text{SLG} = \frac{\text{TB}}{\text{AB}} = \frac{1(1\text{B}) + 2(2\text{B}) + 3(3\text{B}) + 4(\text{HR})}{\text{AB}}$$

PXBH is a statistic that convincingly shows the hitter's potential to influence the game offensively. With a PXBH of over 0.5000, a player will get at least a double once in every two hits. So, if Albert Belle went 2 for 4 in a game last season, we could assume that one of those hits was for extra bases, possibly driving in a run, definitely placing him in scoring position. Using *Total Baseball*<sup>1</sup> as a reference, only two of the top ten leaders in career extra-base hits are also in the top ten PXBH list—Ruth and Gehrig. The top 100 career extra-base hit leaders are listed in Table 1 on the next page, which includes XBH, H, PXBH, and SA (for comparison). Only 21 players in major league history have collected over 1,000 extra-base hits in their careers, and only eight of these players have a PXBH over 0.4000. It is interesting to see in Table 1 that only five players—Greenberg, Ruth, Gehrig, Foxx, and Ted Williams—have a lifetime PXBH over 0.4000 and career slugging percentages over 0.600. Conversely, two players, Dave Kingman

This research was the idea of Rev. Gabriel Costa, a SABR member, who is a Roman Catholic priest of the archdiocese of Newark, New Jersey, and an associate professor of mathematics and computer science at Seton Hall University. In 1988, he began teaching a course in sabermetrics at Seton Hall, and he started offering the course in 1996 at the United States Military Academy (USMA), where he was a visiting professor in the Department of Mathematical Sciences. Lt.-Col. William Fox is professor of Operations Research at USMA and a co-instructor in sabermetrics, as is Maj. Michael Huber, who is also a SABR member and was assistant professor of mathematics at USMA. Mary Ashworth, Dale Edmiston, Jonathan Roginski, and Emett White were all the first sabermetrics students of Rev. Costa at USMA and have been commissioned as lieutenants in the United States Army. The initial article was a combined project of the entire group. The data for 1996 players and teams was added by Maj. Huber and Rev. Costa.

Table 1: Career Extra-base Hits Leaders

Player	Extra Base Hits	Base Hits	PXBH	SA	Player	Extra Base Hits	Base Hits	PXBH	SA
1 Hank Greenberg	781	1628	0.4797	.605	51 Dave Parker	940	2712	0.3466	.471
2 Babe Ruth	1356	2873	0.4720	.690	52 Del Ennis	715	2063	0.3466	.472
3 Mike Schmidt	1015	2234	0.4543	.527	53 Cal Ripken, Jr.	831	2405	0.3455	.455
4 Dave Kingman	707	1575	0.4489	.478	54 Rogers Hornsby	1011	2930	0.3451	.577
5 Lou Gehrig	1190	2721	0.4373	.632	55 Ron Santo	774	2254	0.3434	.464
6 Willie Stargell	953	2232	0.4270	.529	56 Don Baylor	732	2135	0.3429	.436
7 Harmon Killebrew	887	2086	0.4252	.509	57 Jim Rice	834	2452	0.3401	.502
8 Jimmie Foxx	1117	2646	0.4221	.609	58 Al Simmons	995	2927	0.3399	.535
9 Ted Williams	1117	2654	0.4209	.634	59 Yogi Berra	728	2150	0.3386	.482
10 Willie McCovey	920	2211	0.4161	.515	60 Eddie Murray	1089	3218	0.3384	.480
11 Reggie Jackson	1075	2584	0.4160	.490	61 Carl Yastrzemski	1157	3419	0.3384	.462
12 Dick Allen	750	1848	0.4058	.534	62 Goose Goslin	921	2735	0.3367	.500
13 Eddie Mathews	938	2315	0.4052	.509	63 Dan Brouthers	771	2296	0.3358	.519
14 Frank Robinson	1186	2943	0.4030	.537	64 Graig Nettles	746	2225	0.3353	.421
15 Willie Mays	1323	3283	0.4030	.557	65 Harry Heilmann	876	2660	0.3293	.520
16 Johnny Mize	809	2011	0.4023	.562	66 Roger Connor	812	2467	0.3291	.486
17 Duke Snider	850	2116	0.4017	.540	67 Al Kaline	972	3007	0.3232	.480
18 Joe DiMaggio	881	2214	0.3979	.579	68 Joe Morgan	813	2517	0.3230	.427
19 Mickey Mantle	952	2415	0.3942	.557	69 Tris Speaker	1131	3514	0.3219	.500
20 Hank Aaron	1477	3771	0.3917	.555	70 Cecil Cooper	703	2192	0.3207	.466
21 Ernie Banks	1009	2583	0.3906	.500	71 Charlie Gehringer	904	2839	0.3184	.480
22 Jack Clark	711	1826	0.3894	.476	72 Vada Pinson	868	2757	0.3148	.442
23 Johnny Bench	794	2048	0.3877	.476	73 Ted Simmons	778	2472	0.3147	.437
24 Dwight Evans	941	2446	0.3847	.470	74 Mickey Vernon	782	2495	0.3134	.428
25 Earl Averill	767	2019	0.3799	.534	75 Ed Delahanty	808	2597	0.3111	.505
26 Bob Johnson	779	2051	0.3798	.506	76 Rusty Staub	838	2716	0.3085	.431
27 Stan Musial	1377	3630	0.3793	.559	77 Enos Slaughter	730	2383	0.3063	.453
28 Fred Lynn	737	1960	0.3760	.484	78 Robin Yount	960	3142	0.3055	.430
29 Andre Dawson	1039	2774	0.3745	.484	79 Lou Whitaker	701	2296	0.3053	.423
30 Dale Murphy	787	2111	0.3728	.469	80 Henne Manush	761	2524	0.3015	.479
31 Mel Ott	1071	2876	0.3724	.533	81 Al Oliver	825	2743	0.3008	.451
32 Chuck Klein	772	2076	0.3719	.543	82 Sam Crawford	864	2961	0.2918	.452
33 Gil Hodges	713	1921	0.3712	.487	83 Honus Wagner	993	3415	0.2908	.466
34 Bobby Bonds	700	1886	0.3712	.471	84 Steve Garvey	755	2599	0.2905	.466
35 George Foster	702	1925	0.3647	.480	85 Jimmy Ryan	726	2502	0.2902	.444
36 Gabby Hartnett	696	1912	0.3640	.489	86 Paul Waner	909	3152	0.2884	.473
37 Reggie Smith	734	2020	0.3634	.489	87 Brooks Robinson	818	2848	0.2872	.401
38 Jim Bottomley	835	2313	0.3610	.500	88 Paul Molitor	857	3014	0.2843	.453
39 Carlton Fisk	844	2356	0.3582	.457	89 Roberto Clemente	846	3000	0.2820	.475
40 Lee May	725	2031	0.3570	.459	90 Willie Davis	715	2561	0.2792	.412
41 George Brett	1119	3154	0.3548	.487	91 Nap Lajoie	903	3242	0.2785	.467
42 Hal McRae	741	2091	0.3544	.454	92 Jake Beckley	802	2930	0.2737	.435
43 Tony Perez	963	2732	0.3525	.463	93 Ty Cobb	1136	4189	0.2712	.512
44 Dave Winfield	1093	3110	0.3514	.476	94 Zack Wheat	780	2884	0.2705	.450
45 Joe Cronin	803	2285	0.3514	.468	95 Bill Buckner	721	2715	0.2656	.408
46 Darrell Evans	779	2223	0.3504	.431	96 Lou Brock	776	3023	0.2567	.410
47 Orlando Cepeda	823	2351	0.3501	.499	97 Cap Anson	749	2995	0.2501	.466
48 Billy Williams	948	2711	0.3497	.492	98 Frankie Frisch	709	2880	0.2462	.432
49 Joe Medwick	858	2471	0.3472	.505	99 Pete Rose	1041	4256	0.2446	.409
50 Gary Carter	726	2092	0.3470	.439	100 Sam Rice	716	2987	0.2397	.427

and Reggie Jackson, have high extra-base hit percentages yet career slugging percentages below .500.

The mention of Ruth conjures up thoughts of a great home run hitter. His 714 homers rank second all-time, and he single-handedly out-homered entire teams 90 times from 1918 to 1932! The Sultan of Swat also had 1,356 extra-base hits, third highest in history. Only 52.6 percent of his extra-base hits were home runs. He stands 28th on the career doubles list with 506, and his 136 triples put him 69th all time. Ruth's PXBH is 0.4720, second all time. His career slugging percentage is 0.690, which is the highest ever, but it does not completely indicate his power potential. A slugging percentage of 0.690 roughly means that Ruth had two bases for every three at-bats. His career PXBH translates to at least a double for every second hit. From a power point of view, he drove in a run, or got in position to be driven in, with every second base hit over his entire career.

Hank Aaron, who compiled 1,477 lifetime extra-base hits, ends up 20th on the career PXBH list with a value of 0.3917, almost 0.0900 below the career leader, Hank Greenberg. Greenberg dominated the majors in PXBH from 1934 to 1938. Consider Ty Cobb, one of the greatest hitters ever. Cobb's lifetime average was .364. He got 4,189 hits in his career, of which 1,136 were for extra bases, 8th all-time. However, Cobb's PXBH is 0.2712, 93rd on the career list, despite a career slugging percentage of .512. Pete Rose is number 99 on the all-time PXBH list. His 1,041 extra-base hits of the record 4,256 hits leave him with a PXBH of 0.2446. How did other big hitters fare? Dave Kingman had only 1,575 hits in his career, with 442 home runs (62.5 percent of his extra-base hits were homers). His home run percentage ties him with Mickey Mantle. Kingman's career PXBH is 0.4489, 4th highest in history. The Commerce Comet falls in at 0.3942, one notch above Hank Aaron. The most astonishing player in the career category is Harmon Killebrew. He had 887 extra-base hits, with 573 home runs. This equates to almost 65 percent of his XBH being blasts. He still ranks 7th all-time on the PXBH list at 0.4252.

The individual season PXBH is ranked and shown in Table 2<sup>2</sup>. Ruth makes the top 100 nine times, Hank Greenberg seven times, and Lou Gehrig and Mike Schmidt six times each. Ruth is in the top ten list three times. His first season in the majors, 1915, would rank 20th, since he had 15 extra-base hits out of a total of 29 hits. Even then he averaged better than a double with one out of every two hits. Belle's, 0.5954 PXBH performance in 1995 is an awesome

indicator of power. He also posted impressive PXBH figures in 1993 (0.4477) and 1994 (0.4966).

The individual list contains players with at least 70 XBH in a season<sup>3</sup>. 1996 was a banner year for extra base hits. Ten players from the American League alone and six from the National League entered the top 100 individual season list, with five, Mark McGwire (0.5530), Henry Rodriguez (0.5374), Brady Anderson (0.5349), Todd Hundley (0.5286), and Ed Sprague (0.5000), breaking the 0.5000 level. It is interesting to note that McGwire and Anderson also hit at least 50 home runs in 1996. Belle was the only player in 1995 to break the 0.5000 mark. Other recent players include Frank Thomas in 1994 (0.5177), Barry Bonds (0.5102) in 1992, and Howard Johnson (0.5205) and Jose Canseco (0.5000) in 1991.

Joe DiMaggio's famous 1941 season does not make the top 100. His PXBH was 0.4352. During his 56-game hitting streak, he had 35 extra-base hits (15 HR, 4 3B, 16 2B) out of 91 hits. Ted Williams' 1941 season in which he batted .406 also does not make the top 100, since his PXBH was only 0.3946 (73 XBH in 185 hits). Finally, regarding the single-season records, only eight of the ten players to have more than 100 extra-base hits make our top 100 list. Chuck Klein had 107 extra-base hits in 1930, but his 250 overall hits gave him a PXBH of 0.4280. Coincidentally, Rogers Hornsby had 250 hits in 1922 and also had over 100 extra-base hits (102), but his PXBH was only 0.4080.

How does PXBH describe a team's power? In the shortened 1994 season, the Cleveland Indians had a PXBH of 0.3665 in 115 games. This equates to *better than every third hit being at least a double*. How many managers would like to have that "guarantee"? The 1994 Astros are right behind the Indians, with a team PXBH of 0.3612, also in 115 games. However, both teams were in second place in their divisions at the time of the strike. Regarding teams from a full season, 1996 again fills the chart. The 1996 Orioles, Mariners, and Athletics each broke the 1961 Yankees season home run record of 240, and the three teams, in that order, top the list shown in Table 3. The 1996 Baltimore Orioles have set the new record for a team with a PXBH of 0.3757. In fact, ten teams from 1996 made the top 23 teams of all time. This table only includes those teams with at least 500 XBH (except for 1994). The 1953 Dodgers and 1936 Yankees are the only teams in the top ten *not* from this decade! The 1996 Mariners broke every extra-base hit record previously held by the 1936 Yankees, including most extra-base hits, most total bases, and most extra bases

Table 2: PXBH Leaders (Individual Season)

	Player	Extra Base Hits	Base Hits	PXBH		Player	Extra Base Hits	Base Hits	PXBH
1	Albert Belle 1995	103	173	0.5954	51	Juan Gonzalez 1996	82	170	0.4824
2	Babe Ruth 1921	119	204	0.5833	52	Juan Gonzalez 1993	80	166	0.4819
3	Willie Stargell 1973	90	156	0.5769	53	Ralph Kiner 1951	79	164	0.4817
4	Babe Ruth 1920	99	172	0.5756	54	Ken Griffey, Jr. 1993	86	180	0.4778
5	Reggie Jackson 1969	86	151	0.5695	55	Hank Greenberg 1934	96	201	0.4776
6	Mark McGwire 1996	73	132	0.5530	56	Mike Schmidt 1976	73	153	0.4771
7	Kevin Mitchell 1989	87	158	0.5506	57	Jay Buhner 1996	73	153	0.4771
8	Gorman Thomas 1979	74	136	0.5441	58	Manny Ramirez 1996	81	170	0.4765
9	Mike Schmidt 1979	74	137	0.5401	59	Willie Mays 1962	90	189	0.4762
10	Babe Ruth 1919	75	139	0.5396	60	Albert Belle 1996	89	187	0.4759
12	Hank Greenberg 1946	78	145	0.5379	61	Johnny Bench 1970	84	177	0.4746
13	Henry Rodriguez 1996	79	147	0.5374	62	Ted Williams 1946	83	176	0.4716
14	Lou Gehrig 1927	117	218	0.5367	63	Dave Kingman 1979	72	153	0.4706
15	Mike Schmidt 1975	75	140	0.5357	64	Hank Aaron 1969	77	164	0.4695
16	Brady Anderson 1996	92	172	0.5349	65	Jimmie Foxx 1932	100	213	0.4695
17	Todd Hundley 1996	74	140	0.5286	66	Andres Galarraga 1996	89	190	0.4684
18	Babe Ruth 1928	91	173	0.5260	67	Harmon Killebrew 1961	73	156	0.4679
19	Hank Greenberg 1939	82	156	0.5256	68	Frank Robinson 1966	85	182	0.4670
20	Harmon Killebrew 1962	70	134	0.5224	69	Jimmie Foxx 1938	92	197	0.4670
21	Howard Johnson 1991	76	146	0.5205	70	Ken Griffey, Jr. 1996	77	165	0.4667
22	Reggie Jackson 1975	78	150	0.5200	71	Hack Wilson 1930	97	208	0.4663
23	Frank Thomas 1994	73	141	0.5177	72	Mickey Mantle 1961	76	163	0.4663
24	Mike Schmidt 1980	81	157	0.5159	73	Gary Sheffield 1996	76	163	0.4663
25	Hank Greenberg 1937	103	200	0.5150	74	Willie McCovey 1969	73	157	0.4650
26	Barry Bonds 1992	75	147	0.5102	75	Harmon Killebrew 1969	71	153	0.4641
27	Mike Schmidt 1977	76	149	0.5101	76	Lou Gehrig 1929	77	166	0.4639
28	Roger Maris 1961	81	159	0.5094	77	Lou Gehrig 1926	83	179	0.4637
29	Willie Mays 1964	87	171	0.5088	78	Fred Lynn 1979	82	177	0.4633
30	Hank Greenberg 1940	99	195	0.5077	79	Babe Ruth 1930	86	186	0.4624
31	Babe Ruth 1927	97	192	0.5052	80	Jimmie Foxx 1933	94	204	0.4608
32	Stan Lopata 1956	72	143	0.5035	81	Babe Ruth 1924	92	200	0.4600
33	Mark McGwire 1987	81	161	0.5031	82	Stan Musial 1953	92	200	0.4600
34	Jose Canseco 1991	76	152	0.5000	83	Ralph Kiner 1949	78	170	0.4588
35	Ed Sprague 1996	73	146	0.5000	84	Robin Yount 1980	82	179	0.4581
36	Ralph Kiner 1950	74	149	0.4966	85	Lee May 1970	70	153	0.4575
37	Albert Belle 1994	73	147	0.4966	86	Frank Howard 1968	75	164	0.4573
38	Jim Gentile 1961	73	147	0.4966	87	Rudy York 1940	85	186	0.4570
39	Jeff Bagwell 1994	73	147	0.4966	88	Chuck Klein 1932	103	226	0.4558
40	Ernie Banks 1960	80	162	0.4938	89	Willie Mays 1959	82	180	0.4556
41	Eddie Mathews 1953	86	175	0.4914	90	Lou Gehrig 1930	100	220	0.4545
42	Edgar Martinez 1996	80	163	0.4908	91	Earl Averill 1934	85	187	0.4545
43	Willie Stargell 1971	74	151	0.4901	92	Carl Yastrzemski 1969	70	154	0.4545
44	Howard Johnson 1989	80	164	0.4878	93	Lou Gehrig 1936	93	205	0.4537
45	Reggie Jackson 1977	73	150	0.4867	94	John Mayberry 1975	73	161	0.4534
46	Barry Bonds 1993	88	181	0.4862	95	Barry Bonds 1996	72	159	0.4528
47	Hank Greenberg 1938	85	175	0.4857	96	Mel Ott 1929	81	179	0.4525
48	Cecil Fielder 1990	77	159	0.4843	97	Jeff Bagwell 1996	81	179	0.4525
49	Babe Ruth 1923	99	205	0.4829	98	Lou Gehrig 1934	95	210	0.4524
50	Hank Greenberg 1935	98	203	0.4828	99	Jim Thome 1996	71	157	0.4522
					100	Greg Luzinski 1977	77	171	0.4503

Table 3: PXBH Team Leaders

	Team	Extra Base Hits	Base Hits	PXBH	SLG		Team	Extra Base Hits	Base Hits	PXBH	SLG
1	1996 Orioles	585	1557	0.3757	.473	13	1980 Brewers	537	1555	0.3453	.448
2	1996 Mariners	606	1625	0.3729	.484	14	1979 Red Sox	538	1567	0.3433	.456
3	1996 Athletics	547	1492	0.3666	.453	15	1977 Red Sox	527	1551	0.3398	.465
4	1994 Indians (115 G)	427	1165	0.3665	.484	16	1940 Red Sox	526	1566	0.3359	.449
5	1994 Astros (115 G)	397	1099	0.3612	.445	17	1927 Yankees	552	1644	0.3358	.489
6	1996 Rangers	576	1631	0.3551	.469	18	1996 Red Sox	547	1631	0.3354	.456
7	1996 Blue Jays	514	1451	0.3542	.420	19	1930 Yankees	560	1683	0.3327	.488
8	1953 Dodgers	541	1529	0.3538	.474	20	1996 Brewers	522	1577	0.3310	.441
9	1936 Yankees	580	1676	0.3461	.483	21	1936 Indians	562	1715	0.3277	.461
10	1996 Indians	576	1665	0.3459	.475	22	1996 White Sox	512	1586	0.3228	.447
11	1987 Tigers	531	1535	0.3459	.451	23	1921 Yankees	506	1576	0.3211	.464
12	1996 Rockies	555	1607	0.3454	.472						

on extra-base hits. The great 1927 New York Yankees team, in comparison, ranks 17th in our study, with a team PXBH of 0.3358. As a final note, the 1996 American League (14 teams), had a combined *league* PXBH of 0.3360, higher than eight teams on our list. In 1996, the 14 teams set new records for most extra-base hits (7,366), most 2Bs (4,204), most HRs (2,742), and most hits (21,921). The 1996 National League's PXBH was 0.3155. This year's NL also set new records for extra-base hits (6,436), 2Bs (3,782), and HRs (2,220).

This study provides a good indicator of ways in which a hitter's power can influence the national pastime. This statistic is purely offensive and does not take any pitching or ballpark factors into account.

Yet, the percentage of extra-base hits (PXBH) is another way to look at the offense. While new players may break into the single-season and career records, those players will have a definite impact on the offensive power of a baseball team.

Notes:

1. *Total Baseball*, Fourth Edition, edited by John Thorn and Pete Palmer with Michael Gershman, Viking (Penguin Books), New York, 1995.
2. The table of individual PXBH seasons was compiled *without* the use of an automated database. We apologize for any errors or omissions, and we welcome information on any players to be included in the table.
3. 70 extra-base hits was chosen as an arbitrary cutoff. In 1992, for example, Mark McGwire had 64 extra-base hits out of 125 hits, giving him a PXBH of 0.5120.



HEY JOE! KIDS DELAY GAME FOUR TIMES

Four times youngsters ran out on the field to ask Joe DiMaggio for his autograph during the second game of the twin-bill at Yankee Stadium, July 25. The invasion started when DiMag obliged one tot who dashed out to centerfield between innings after Joe had hit a homer. The park announcer asked parents to keep their children off the field, but the crowd of 45,000 hooted. It is believed that television is one reason for kids running out on the field—parents want their offspring to get in on the act. (From *The Sporting News*, August 4, 1948.)

—Andy Moursund