

ARM-Average Run equivalent Method
by Clem Comly June 20, 2000

I would like to present my findings on a method to analyze more completely the ability of outfielders to shut down the running game. In the past OF assists and anecdotal evidence were used. More recently, the STATS Scoreboard has presented the percentage of runners who have taken the extra base when the opportunity was provided. Let's call this new method ARM (Average Run equivalent Method). ARM takes into account assists, extra bases taken by either the batter or the runner, and errors made by the outfielder whenever a single is fielded with runners on first and/or second (regardless of the third base runner situation). ARM, which requires play-by-play data was used for most of the major league games from 1959 to 1987 (thanks to Retrosheet and the Baseball Workshop). Data for different OF positions are kept separate. Among other questions ARM could let us answer is what is the difference between having Greg Luzinski in LF rather than Carl Yastrzemski for a full season (and the answer is not 43 pounds despite what TB says).

First, we use play-by-play (p-b-p) to identify situations where we know a single was hit to a specific outfielder. ARM notes his name, the outs and the runner positions before the hit, and the result. If there was no runner on first nor on second, ARM discards the result. If there is a runner on 3B also, 99% of the time we throw that runner away but keep the result of the other runners. The less than 1% of the time where the OF throws out the runner from 3B at home, ARM treats as if the runner on 3B had been on second. Any subsequent infielder error or pick-off of a runner is not recorded as the actual result, but instead a best guess of the result without that extraneous play. The OF gets no credit for the out on the bases unless he gets an assist, but he does get credit for an out when he gets an assist but the runner was actually safe when an infielder dropped the throw for an error.

So in effect there are 9 starting states: 3 out possibilities multiplied by three runner situations: man on first (100 below), man on second (020), and men on first and second (120). For each event from the p-b-p, ARM records the resulting runner positions, any out that was made by the OF's throw (+ below), and any runs scoring (- is 1 run, = is two runs). When ARM has finished for a particular OF for a particular position, ARM uses Pete Palmer's expected runs (see The Hidden Game of Baseball, p.153) for the resulting out and base situation and adds 1 for each run scored. This sum is multiplied by the number of times that result was achieved on a single to that OF and all of these sums are added together and then ARM subtracts the product of the average expected runs for each state for that OF position and the number of times the OF handled a single in each initial state.

In the period 1959-1987, for instance, two center fielders with similar raw numbers are shown below:

Name	S	MS	S w/ 1/2/12	Assists on 1/2/12
Rick Miller	1313	116	539	16
Jose Cardenal	1342	164	561	19

To interpret the headings, in that period the p-b-p showed 1313 singles hit to CF while Miller was playing there. Some singles in the p-b-p are anonymous in terms of who fielded them. While Miller was in CF, there were 116 that on a pro rata basis were hit to him which I will call MS (missing singles). These 116 are strictly to show the level of accuracy of the p-b-p and are not included in the 1313. ARM looked at the 539 singles of the 1313 that happened with runners on first and/or second regardless of the runner on 3B. Miller garnered 16 assists after fielding those 539 singles. Looking at Cardenal, his assist total is significantly higher while the singles are a little higher. Calculating the ARM for Miller on those 539 hits, he saved his team 9 runs for his career from 1959-1987 compared to the baseline CF. This can be broken down into the three base runner starting positions which, allowing for rounding, add up to that -9.0.

	Net	=Net	+Net	+Net
Runs	1	2	12	
ARM				
Rick Miller	-9.0	-2.7	-2.7	-3.5
Jose Cardenal	5.2	9.6	-3.6	-0.7

Cardenal is worse, for the most part, due to his performance with a runner on first without a runner on second. What was the problem? Let's add together the 0 out, 1 out, and 2 out events and compare them to get an idea.

CF man on first not on second (symbolized as 100, where 123 is bases loaded, 103 is first and third occupied, etc.), SUM* of 0 outs, 1 out, and 2 outs

		Result situations								
Name	Opp	100+	020+	003+	120	103	023	100-	020-	003-
Rick Miller	292	3	0	1	194	81	4	0	8	1
Jose Cardenal	288	5	1	3	127	126	16	5	4	1

*NOTE: ARM calculates for each out situation separately. The summarization is simply to make it easier for the reader to evaluate the data.

As an example, the ending expected run values for a starting case of 1 out and one runner on (beginning runner position is irrelevant) are:

100+	020+	003+	120	103	023	100-	020-	003-
.209	.348	.382	.888	1.088	1.371	1.478	1.699	1.897

The baseline CF result average is 0.975 for the starting situation of one out and a runner on first. Cardenal threw out more runners (9 (5+1+3) to 4 (3+0+1)) and was only slightly worse in allowing the runner to score from first (10 (5+4+1) to 9 (0+8+1)). Cardenal's problem was the runner was going to third almost half the time (49%, (126+16)/288) while Miller was at 30% ((81+4)/292). ARM balances these factors and shows Miller is more valuable.

Let's look at a gold glove versus a hitter, Yaz versus Luzinski. Key:

GS Games Started in LF

S singles fielded

MS prorated unidentified singles

TS singles fielded with a runner on 1B and/or 2B regardless of 3B (excluding MS)

ARM equivalent runs minus base line LF

A assists on singles fielded with man on 1B and/or 2B regardless of 3B

Yastrzemski

Season	GS	S	MS	TS	ARM	A	
1961	146	238	16	111	0	6	
1962	160	192	89	87	-1	5	
1963	150	197	71	74	-2	6	
1964	16	30	3	11	-1	1	primarily CF
1965	115	111	100	46	-3	4	
1966	151	160	91	63	-8	8	
1967	157	194	30	82	-7	8	
1968	152	212	44	88	-3	5	
1969	138	248	10	108	-7	8	
1970	64	126	7	52	-1	0	primarily 1B
1971	144	272	9	127	-9	11	
1972	82	139	26	71	-1	4	
1973	15	36	5	13	1	0	primarily 1B
1974	62	82	12	31	0	0	primarily 1B
1975	8	4	10	1	0	0	primarily 1B
1976	51	113	10	44	-2	2	primarily 1B
1977	138	209	57	87	-7	9	
1978	63	102	17	47	-1	2	
1979	34	56	6	24	-3	1	primarily DH
1980	32	34	6	11	1	0	primarily DH
1983	1	2	0	2	-0	0	primarily DH
ALL	1879	2757	630	1010	-56	79	

Luzinski

Season	GS	S	MS	TS	ARM	A
1972	145	145	32	47	2	2
1973	157	199	36	89	-1	5
1974	81	128	3	51	-1	4
1975	159	255	2	111	1	6
1976	144	206	1	71	2	3
1977	148	200	0	86	2	3
1978	154	195	0	70	-3	2
1979	124	185	0	74	3	1
1980	105	148	1	61	2	2
ALL	1217	1661	82	660	9	28

both were starting in LF at age 21 (below are seasons primarily at LF)

													Ave.
Yaz	ARM	0	-1	-2*	-3	-8	-7	-3	-7	-9	-1	*	-4.1
Yaz	A	6	5	6	4	8	8	5	8	11	4		6.5
Luz	ARM	2	-1	-1	1	2	2	-3	3	2			1.3
Luz	A	2	5	4	6	3	3	2	1	2			4.0

* five years later Yaz will go back to LF

Finally, let's look at the best and worst single season and career ARMs for each OF position.

best and worst single season ARMs

LF		CF		RF				
1978	S.Hendersn	-10.7	1976	Beniquez	-12.4	1963	Callison	-10.9
1978	Cromartie	-10.6	1980	O.Moreno	-10.7	1974	G.Gross	-10.6
1985	J.Leonard	-10.5	1983	E.Milner	-10.6	1978	E.Valentn	-10.3
1971	Yaz	-9.5	1978	Dawson	-9.2	1985	Barfield	-10.3
1983	J.Leonard	-8.8	1982	Dw.Murphy	-9.2	1986	vanSlyke	-9.7
1982	Lon.Smith	-8.5	1974	Geronimo	-9.1	1987	Barfield	-8.9
1973	Stargell	-8.3	1972	Unser	-9.0	1977	J.Clark	-8.3
1980	LeFlore	-8.0	1968	Berry	-8.2	1973	K.Singltn	-8.2
1974	Rose	-7.6	1980	Dw.Murphy	-8.2	1986	G.Wilson	-8.0
1966	Yaz	-7.7	1973	Cedeno	-7.7	1987	G.Wilson	-7.7
...				
1971	F.Howard	4.4	1961	K.Hunt	4.0	1984	C.Washngtn	4.8
1961	Minoso	4.4	1967	Pepitone	4.0	1980	G.Matthews	4.8
1967	J.Alou	4.5	1966	CleonJones	4.1	1964	Christopher	4.8
1978	Page	4.7	1968	Reg.Smith	4.3	1975	Burroughs	5.4
1982	Winfield	4.9	1969	Reg.Smith	4.6	1980	Griffey	5.6
1965	F.Howard	5.2	1965	Flood	4.9	1960	J.Cunngm	6.3
1968	F.Howard	5.1	1962	Bruton	5.0	1969	T.Coniglro	7.1
1975	Kingman	5.1	1968	T.Gonzalez	5.0	1969	K.Harrelson	7.2
1963	L.Wagner	6.0	1970	Cardenal	5.2	1960	Allison	7.3
1964	L.Wagner	6.1	1959	Ashburn	5.8	1977	Burroughs	7.5
1968	R.Allen	6.3	1964	Cowan	5.9	1967	Swoboda	7.8
			1983	G.Thomas	6.9			

LF ARM career 1959-1987

CF ARM career 1959-1987

RF ARM career 1959-1987

Name	S	MS	ARM	Name	S	MS	ARM	Name	S	MS	ARM
Yaz	2757	630	-56	Dw.Murphy	1461	616	-38	Callison	2189	55	-39
J. Rice	2006	958	-26	Cedeno	2165	632	-35	Barfield	854	437	-38
Wil.Wilson	1103	48	-24	Geronimo	1557	133	-29	Clemente	2257	478	-34
Stargell	1507	314	-21	Dawson	1652	272	-29	J.Clark	1324	148	-28
J.Leonard	643	490	-21	G.Maddox	2609	375	-28	E.Valentine	1058	174	-26
Lon.Smith	740	418	-20	Blair	2472	343	-27	Dw.Evans	2163	912	-25
Raines	891	346	-19	O.Moreno	1966	240	-26	O.Brown	1030	148	-23
R.Henderson	1050	270	-18	W. Mays	3206	618	-26	Glen.Wilson	606	368	-20
Cromartie	649	142	-17	Dal.Murphy	1207	703	-25	Hank Aaron	1775	352	-18
George Bell	472	365	-15	Willi.Davis	3740	201	-24	Parker	2157	511	-18
Oglivie	1783	468	-15	Del Unser	1995	94	-23	Winfield	1784	611	-17
Page	386	119	7	Mota	306	54	5	Al Cowens	1627	483	-17
H.Lopez	686	36	8	K.Gibson	234	48	5	G. Gross	497	141	-16
Hinton	628	39	8	Hisle	911	90	5	M.Hershberger	647	296	-16
Brock	3366	308	8	Cardenal	1342	164	5	Pinson	648	60	11
Luzinski	1661	82	9	J.Briggs	476	13	5	K.Harrelson	333	32	11
Al.Johnson	1448	64	9	Cowan	363	19	6	Singleton	1571	285	12
R.White	2613	181	10	Landis	1556	292	6	J.Cunningham	401	11	12
Baylor	994	111	10	Pepitone	579	10	7	Murcer	1161	78	13
Covington	710	60	12	Lenny Green	922	115	7	Fr.Robinson	1355	226	15
L.Wagner	1228	273	21	T.Gonzalez	1503	78	8	C.Washington	1164	435	15
F.Howard	1290	19	22	Ashburn	608	39	12	Allison	822	20	16
								Burroughs	1108	83	20

CONCLUSIONS

The key point of this study is we now have an idea of how much this talent is worth. The difference from absolute best season to worst is about 2 victories (around 20 runs). This is a combination of:

- the limited number of opportunities in a season (usually 50-100 singles with a runner on 1B and/or 2B),
- the talent is one of degree not kind (everybody makes an error now and then and throws out a runner now and then) to season, even the best don't average saving their teams 1 victory compared to an rom season average OF. Of course, the average RF in 1964 was 10% Callison and 10% Clemente. Speaking of Clemente, a Pirate pitcher was quoted on SABR-L that Clemente liked to show off his arm by throwing to third base where there wasn't a play and let the batter get to second hurting the Pirates. Clemente's ARM reflects batters taking second, so overall he didn't hurt the Pirates (as his Gold Gloves also attest to), and
- the refusal of managers to keep putting a real rag arm in the field.

From season to season, even the best don't average saving their teams 1 victory compared to an average OF. Of course, the average RF in 1964 was 10% Callison and 10% Clemente. Speaking of Clemente, a Pirate pitcher was quoted on SABR-L that Clemente liked to show off his arm by throwing to third base where there wasn't a play and let the batter get to second hurting the Pirates. Clemente's ARM reflects batters taking second, so overall he didn't hurt the Pirates (as his Gold Gloves also attest to). As Retrosheet holdings expand towards the present and further into the past, ARM can be calculated for more outfielders in baseball history. This methodology can be used for other studies. The one that springs to mind is base runner evaluation.

Obviously, the average result of a single to LF with a runner on 1B is the result for the average left fielder is in large part the result of the average runner on 1B.

DISCLAIMERS (type enlarged by a factor of 10 for reader's benefit)

I purposely chose singles only because extra base hits are much more a function of the ball park. Also, the sample size is low for singles, for doubles and triples... ARM is limited to the accuracy of the p-b-p which no CPA would sign. More than 95%, but not 100%, of the games were available for the period 1959-1987. There may also be a slight bias that anonymous singles will tend to be hits on which no assist or error occurred. The baseline RF, CF, and LF were the averages of 3 ML seasons, 1961, 1966, 1968, and the NL of 1962 and 1969 which were chosen because of availability at the beginning of the project. For most seasons, the sum of all outfielders is a little better (below) than zero. If that bothers you, consider the baseline a replacement level player. I call this ARM, but it also measures the judgment of the OF and his ability to get into position to throw. Obviously, there may have been some singles that Yaz left his feet on that Luzinski let get by him for extra bases. ARM punishes Yaz for letting the runner go to third on those singles. Defensive average or range factor, which ARM supplements and does not replace, should reward Yaz for that play.

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