



Baseball VI



Produced by Dr. Mario | UNC STOR 538



Player Win Averages

- Let p = Probability My Team Wins (%)
- Let $q = 100 - p$ = Probability Opponent's Team Wins
- How Does an Individual Player Impact p ?
- Winning Probability Difference (WINDIFF)

$$WINDIFF_t = p_t - q_t \text{ where } t = \textit{Time}$$

- WINDIFF Before Game Begins
 - Assume Each Team Equally Likely to Win

$$WINDIFF_0 = 50 - 50 = 0$$





Player Win Averages

- Jeff Sagarin
 - Developed Ranking Methods in Variety of Sports
 - Publishes Rankings in USA Today
 - Known for MLB Player Win Average Analysis (1957-2006)
 - To Avoid Decimals,

$$SAGWINDIFF_t = 10(p_t - q_t) \text{ where } t = \text{Time}$$

- Scenario
 - Home Team Losing by 2 Runs in Bottom of 9th
 - Bases Loaded and Mariano Rivera Comes in to Pitch
 - Current WINDIFF

$$SAGWINDIFF_t = 10(52.3 - 47.7) = 46$$

- Batter Hits into Double Play and 1 Run Scores
- Next WINDIFF

$$SAGWINDIFF_{t+1} = 10(17.2 - 82.8) = -656$$





Player Win Averages

- Scenario
 - Observe the Change in WINDIFF

$$SAGWINDIFF_{t+1} - SAGWINDIFF_t = -656 - 46 = -702$$

- Clearly, Swing Was in Mariano Rivera's Favor
 - Batter Loses 702 Points
 - Mariano Gains 702 Points
 - How Does This Methodology Improve ERA?

- Key Conversion: 2000 SAGWINDIFF = 1 WIN Above 500
 - Changes in SAGWINDIFF For Team = 1000 Points
 - Suppose Team Record is 82W and 80L
 - Across Season

$$82 \times 1000 - 80 \times 1000 = 2000 \text{ Points}$$

- Team Ends Season 1 Game Over .500





Player Win Averages

- Win Average Leaders from 2004 to 2006

Sagarin Win Average Leaders, 2004–6

Year	Player	Position	Total Points	Situations
2006	Albert Pujols	batter (outfield)	+18,950	653
2006	Francisco Rodriguez	relief pitcher	+10,562	312
2005	David Ortiz	outfielder/ designated hitter	+18,145	718
2005	Roger Clemens	starting pitcher	+12,590	852
2004	Barry Bonds	outfielder	+25,398	637
2004	Brad Lidge	relief pitcher	+11,906	382



Player Win Averages



- Applied to Fielding Ability
 - Use of Rating System by John Dewan's *Fielding Bible*
 - Derek Jeter's Rating was -34 (Caused 34 Hits More Than Average)
 - Derek Jeter Cost the Team

$$\begin{aligned}-34 \text{ Hits} &= -0.8 \times 34 \text{ Runs} = -27.2 \text{ Runs} \\ &= -\frac{27.2}{10} \text{ Wins} = -2000 \times 2.72 \text{ Win Points} \\ &= -5,440 \text{ Win Points}\end{aligned}$$

- Adjust Derek Jeter's Win Points by Subtraction
- Historically, Fielding Has Been Overrated
- Based on *Fielding Bible*, Only 7 Players with Positive Fielding Ratings Equivalent to 2 More Wins Above Average.





Player Win Averages

- Applied to Baserunning Ability
 - Good Base Runner Described
 - Rarely Caught Stealing
 - Rarely Caught in Double Plays
 - Able to Take Extra Bases
 - Player Win Averages Reward Stolen Bases and Preventing Double Plays
 - Fast Base Running is not Rewarded by Player Win Averages
 - Analyzed By Dan Fox (Director Of Baseball Informatics for Pirates)
 - Compare Runner's Number of Runs to Average Runner
 - Best Base Running Has Little Effect on SAGWIN





Player Win Averages

- Interesting Application: Hitting Versus Pitching
 - 1969 World Champion New York Mets
 - Table of Player Win Averages
 - Hitters = Bad
 - Pitchers = Good
 - Season 100 Wins
 - Expect 38,000 Win Points
- $(100 - 81) \times 2000 = 38,000$
- Not Equal Because Trades



	Hitters total		Pitchers total	Team total
	-9319		41057	31738
Batter	Winpoints	Pitcher	Winpoints	
Grote	-1960	Seaver	13471	
Kranepool	-765	Koosman	13218	
Boswell	-42	Cardwell	761	
Garrett	-3819	McAndrew	1332	
Harrelson	-131	Ryan	23	
Agee	5410	McGraw	10902	
Jones	6334	Koonce	185	
Swoboda	6278	DiLauro	890	
Shamsky	4998	Taylor	1625	
Weis	-2054	Frisella	-605	
Gaspar	-1772	Jackson	-745	
Pfeil	-3629			
Clendenon	240			
Martin	-2196			
Charles	-1021			
Otis	-1789			
Dyer	-290			



Player Win Averages

- Winning Probabilities for All Game Scenarios
 - Recall: p = Probability My Team Wins (%)
 - How is this Probability Calculated?
 - We Can Use a Massive Set of Play-by-Play Data (1977-2006)
 - Scenarios Based on Inning, Score, Runner Locations, and Outs
 - Problem Some Scenarios Are Rare
 - Advised to Use Markov Chain Monte Carlo (MCMC)





Value of Replacement Players

- **Keith Woolner**
 - Works for the Cleveland Indians
 - Authored for *Baseball Prospectus*
 - Respected for Player Analysis and Market Evaluation
 - Created Value of Replacement Player (VORP)
- **Replacement Player**
 - Players Create Value by Keeping Bad Players Off the Field
 - Acquiring Replacement Players (Minor League)
 - Assume List of Replacement Players is Infinite
 - Woolner Defined Replacement Player as a Player in the Bottom 20% of List Ordered by Plate Appearances
 - Team of Replacement Players Would Get Approximately 44 Wins and 118 Losses





Value of Replacement Players

PA = Plate
Appearance
BFP = Batters Faced

- Value of a Replacement Player Points (VORPP)

- Recall: Each Loss Below .500 = -2,000 SAGWIN
- For All Replacement Players = -74,000 SAGWIN
- Batters and Pitchers Get Equal Blame = -37,000 SAGWIN Points Each
- Approximately 6,200 Plate Appearances in a Season

$$\frac{-37,000}{6,200} = -5.97 \text{ Points Per Plate Appearance}$$

- Formula for Hitters

$$VORPP = SAGWIN + 5.97 \times (PA)$$

- Formula for Pitchers

$$VORPP = SAGWIN + 5.97 \times (BFP)$$



Value of Replacement Players

- VORPP Used to Evaluate Trades

$$\text{Hoffman VORPP} = 7,963 + 5.97(255) = 9,485.$$

$$\text{Young VORPP} = 6,117 + 5.97(781) = 10,780.$$

- VORPP Used to Determine Salary

$$\text{Pujols 2006 value} = 22,848 \times 1,040 = \$23.8 \text{ million.}$$

$$\text{Hoffman 2006 value} = 9,485 \times 1,040 = \$9.9 \text{ million.}$$

$$\text{Young 2006 value} = 10,780 \times 1,040 = \$11.1 \text{ million.}$$

$$\$77M = 74,000 \text{ VORPP}$$

$$\$1,040 = 1 \text{ VORPP}$$



Value of Replacement Players

- Was Alex Rodriguez Overpaid by Yankees? Yes
 - Deal: \$275M for 10 Years

Year	Plate Appearances	SAGWIN Points	VORP Points	Fair Salary in 2006 Dollars (millions)
2003	741	10593	15016.77	\$ 15.62
2004	734	6575	10956.98	\$ 11.40
2005	752	12521	17010.44	\$ 17.69
2006	695	2205	6354.15	\$ 6.61
2007	736	14193	18586.92	\$ 19.33

- Fair Deal Based Off 2007 Statistics
$$\text{\$19.33M} \times 1.05 \times 10 \approx \text{\$202M}$$





Value of Replacement Players

- Extra Plate Appearances Create Value

$$\text{Inge VORPP} = 15 + 5.97(617) = 3,699.$$

$$\text{Therriot VORPP} = 2,480 + 5.97(174) = 3,519.$$

- VORPP Used by Theo Epstein in 2004 Red Sox Season





Wins Above Replacement

- Wins Above Replacement (WAR)
 - Attempt to Measure All of a Baseball's Player's Contributions
 - What is it good for? Absolutely Everything
 - Not Comparing to Average Player but Replacement Player
 - Interpretation: "If a player got injured and their team had to replace them, how many wins would the team be losing?"
- Three Main Sources of WAR
 - Baseball-Reference (bWAR)
 - FanGraphs (fWAR)
 - Baseball Prospectus (WARP)





Wins Above Replacement

- Formula Differs for Position Players and Pitchers
 - Position Players: Batting, Baserunning, and Fielding Measured in Runs Above Average (RAA)
 - Pitchers: Either Based on Runs Allowed Per 9 Innings (RA9) or Fielding Independent Pitching (FIP)
- General Formula for Position Players (fWAR)

$$WAR = (Batting\ Runs + Base\ Running\ Runs + Fielding\ Runs + Positional\ Adjustment + League\ Adjustment + Replacement\ Runs) / (Runs\ Per\ Win)$$





Wins Above Replacement

- Top Players for bWAR Based on Career

Rank	Player (yrs, age)	WAR Position Players	Bats
1.	Barry Bonds (22)	162.8	L
2.	Babe Ruth+ (22)	162.1	L
3.	Willie Mays+ (22)	156.4	R
4.	Ty Cobb+ (24)	151.0	L
5.	Hank Aaron+ (23)	143.0	R
6.	Tris Speaker+ (22)	134.1	L
7.	Honus Wagner+ (21)	130.8	R
8.	Stan Musial+ (22)	128.2	L
9.	Rogers Hornsby+ (23)	127.0	R
10.	Eddie Collins+ (25)	124.0	L





Wins Above Replacement

- Top Players for fWAR Based on 2019 Season

#	Name	Team	Pos	PA	IP	Primary WAR	Total WAR
1	Mike Trout	Angels	CF	600		8.6	8.6
2	Christian Yelich	Brewers	RF	580		7.7	7.7
3	Alex Bregman	Astros	3B/SS	643		7.4	7.4
4	Cody Bellinger	Dodgers	RF	621		7.2	7.2
5	Anthony Rendon	Nationals	3B	595		7.2	7.2
6	Ketel Marte	Diamondbacks	2B/CF	626		7.0	7.0
7	Jacob deGrom	Mets	P		190.0	6.2	6.9
8	Marcus Semien	Athletics	SS	698		6.8	6.8
9	Max Scherzer	Nationals	P		159.2	6.4	6.4
10	Gerrit Cole	Astros	P		192.1	6.5	6.4





Final Inspiration

Yesterday's home runs don't
win today's games.

-Babe Ruth