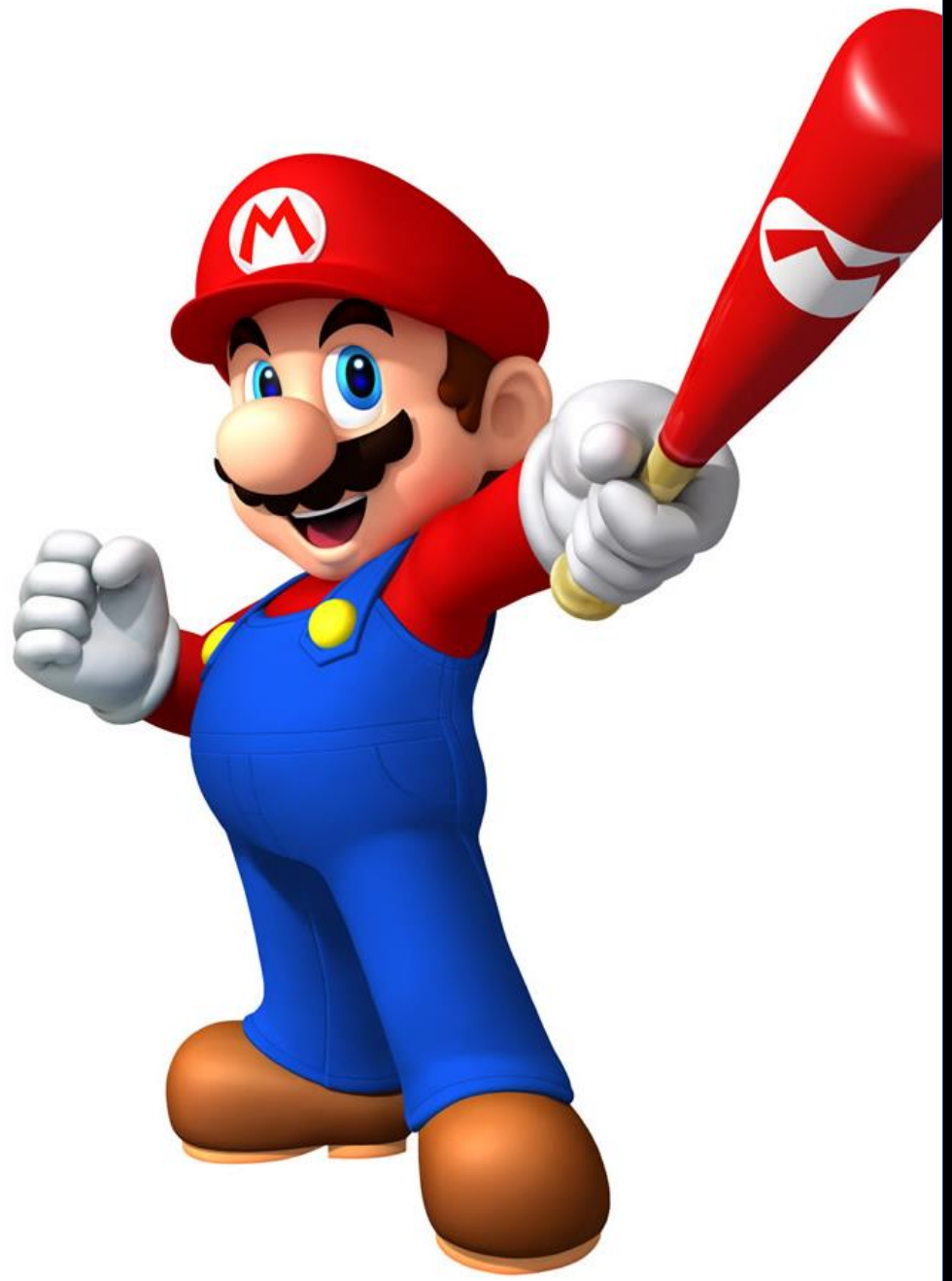
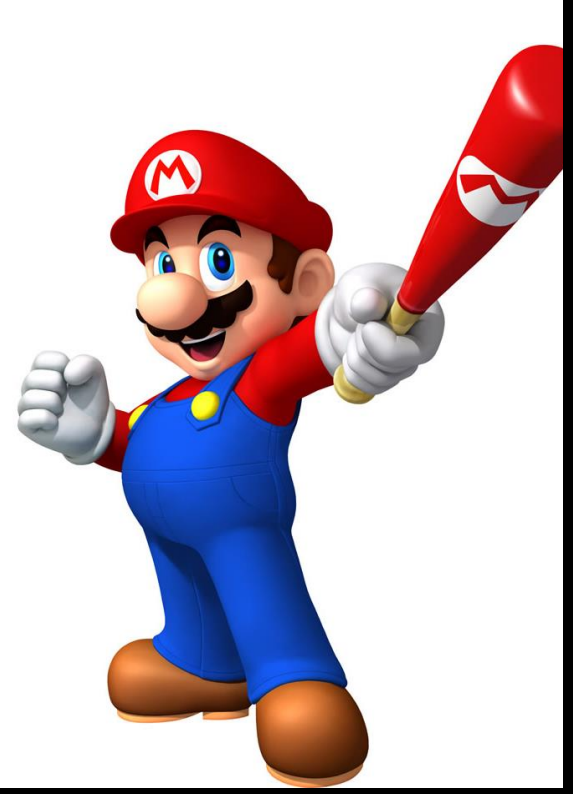


Baseball VI

Produced by Dr. Mario | UNC STOR 390



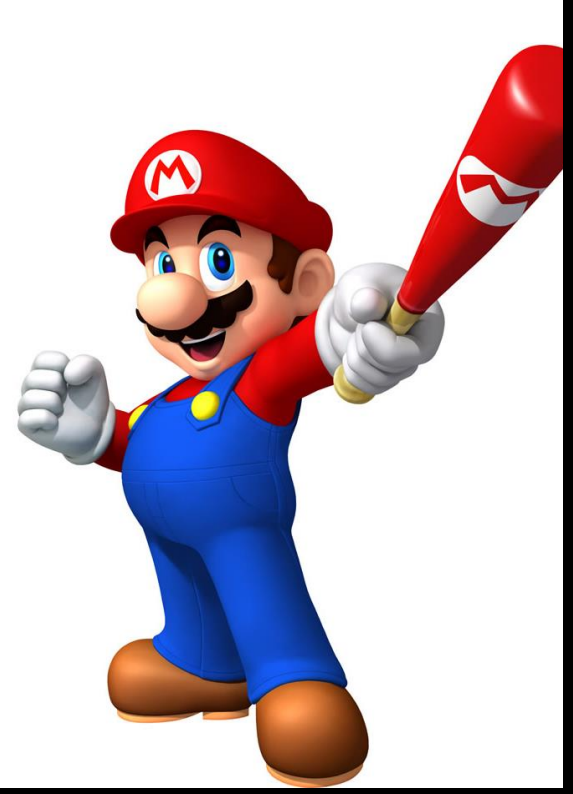
Player Win Averages

- 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)

  $WINDIFF_t = p_t - q_t$ where $t = Time$

- 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,

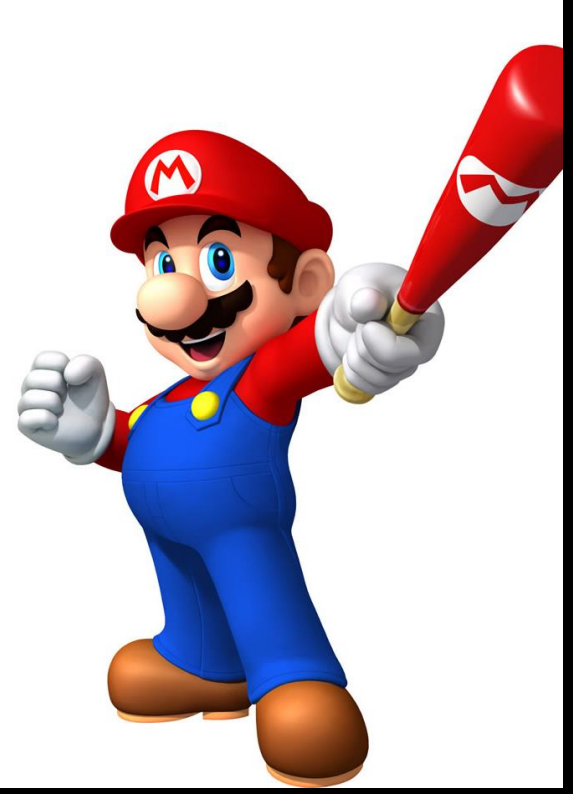
$$SAGWINDIFF_t = 10(p_t - q_t) \text{ where } t = Time$$

- 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

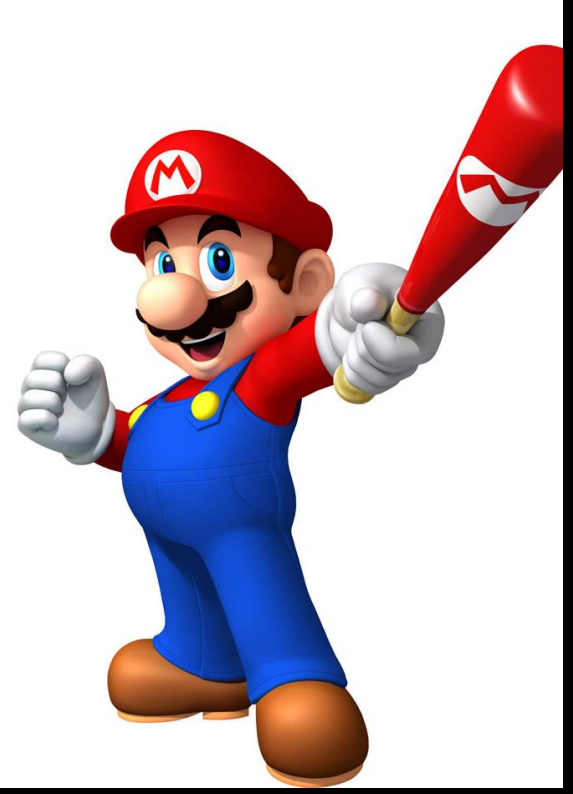
$$SAGWINDIFF_{t+1} - SAGWINDIFF_t = -656 - 46 = -702$$

  - 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

$$82 \times 1000 - 80 \times 1000 = 2000\ Points$$

  - Team Ends Season 1 Game Over .500

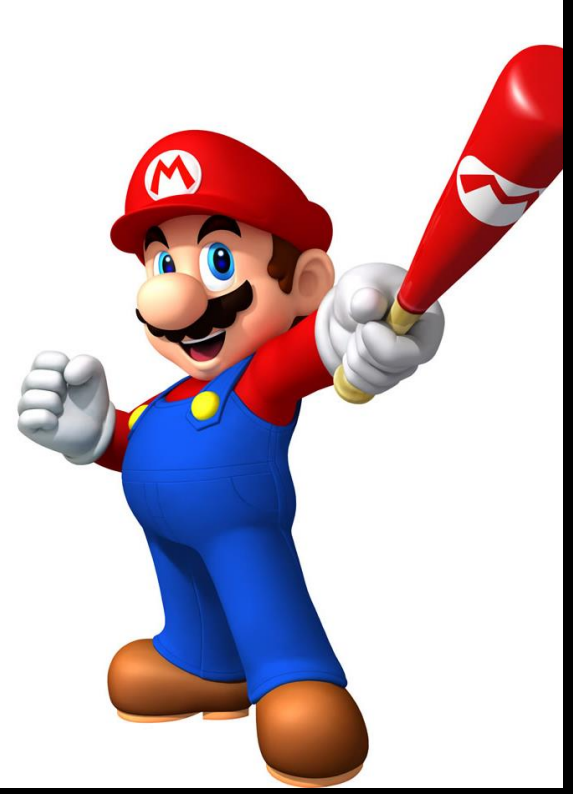


Player Win Averages

- **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

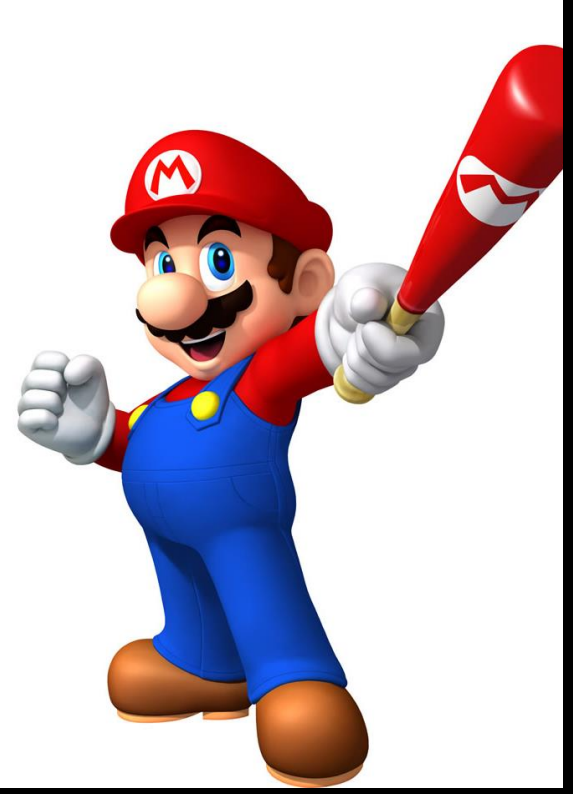


Player Win Averages

- 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

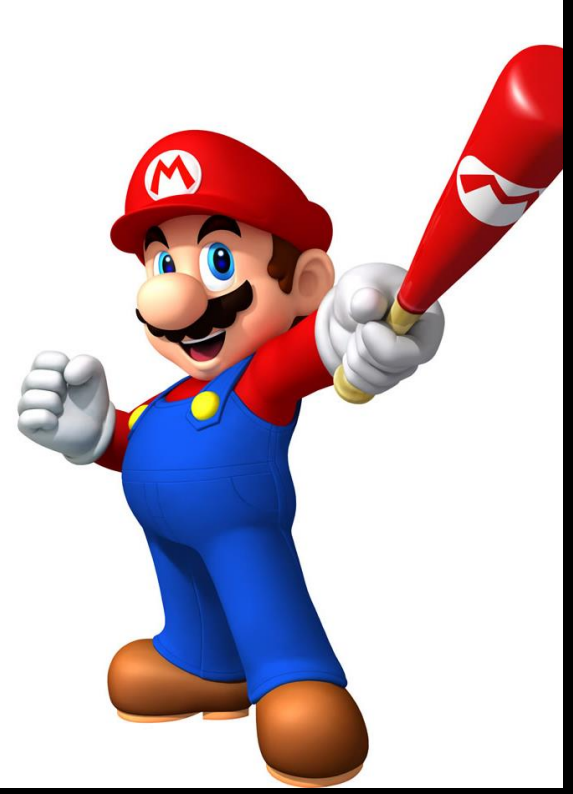
$$-34\ Hits = -0.8 \times 34\ Runs = -27.2\ Runs$$
$$= -\frac{27.2}{10}\ Wins = -2000 \times 2.72\ Win\ Points$$
$$= -5,440\ Win\ Points$$

  - 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
  - Player Win Averages Do Not Reward
  - 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



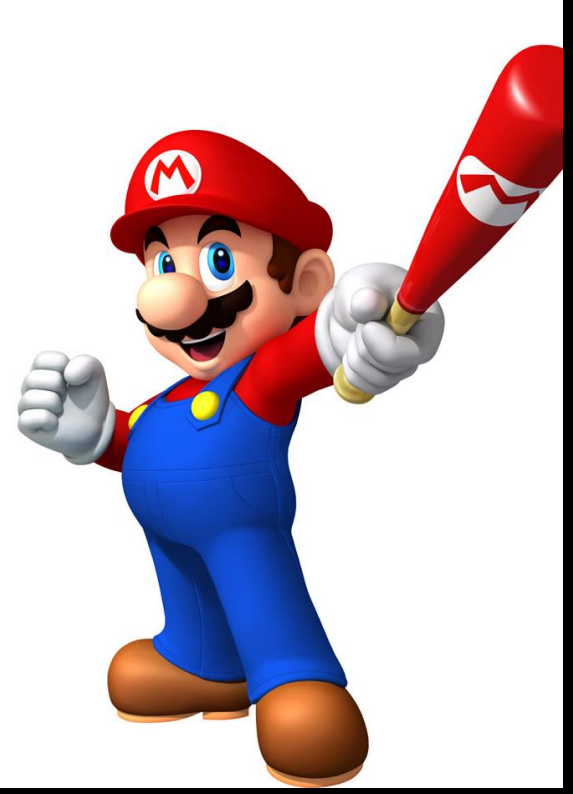
Player Win Averages

- 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

$$(100 - 81) \times 2000 = 38,000$$

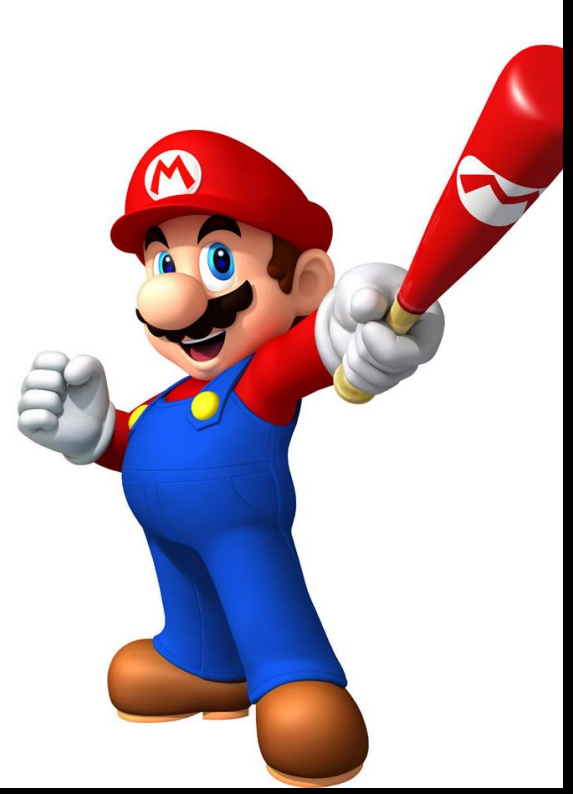
  - Not Equal Because Trades

	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

- Winning Probabilities for All Game Scenarios
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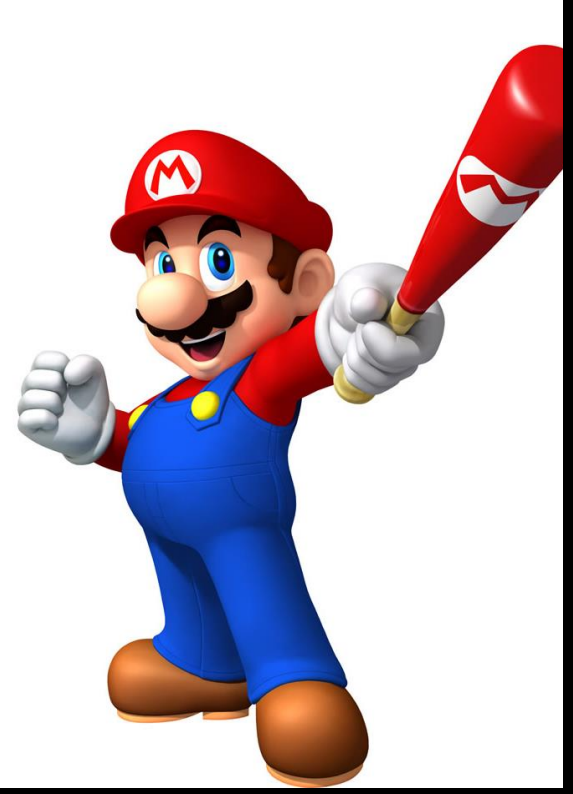
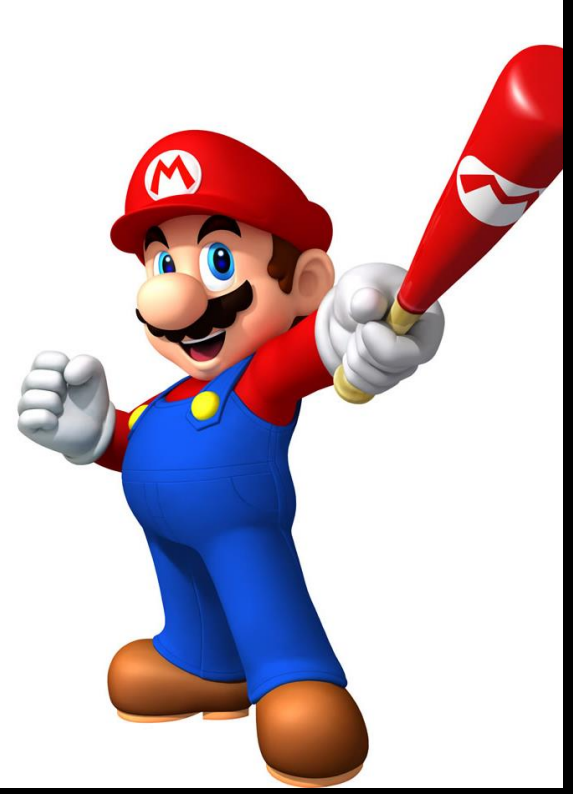


Value of Replacement Players

- 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

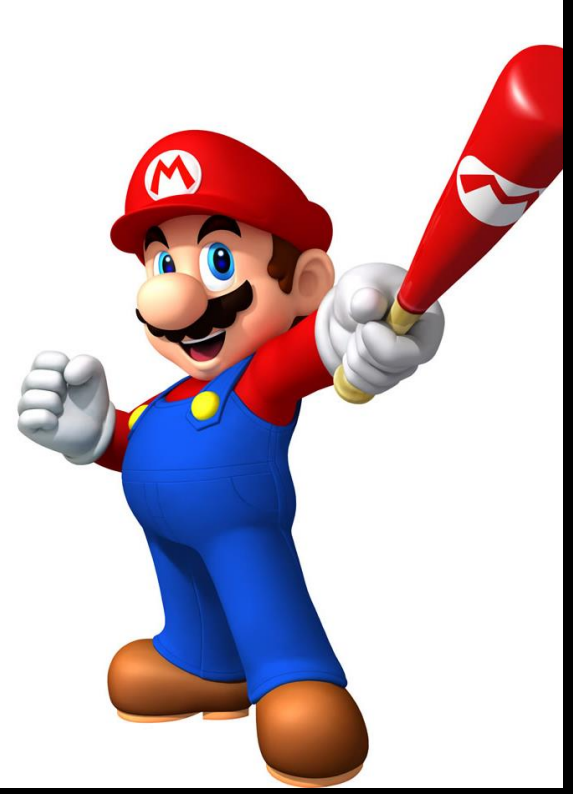
$$\frac{-37,000}{6,200} = -5.97 \; Points \; Per \; Plate \; Appearance$$

  - 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

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

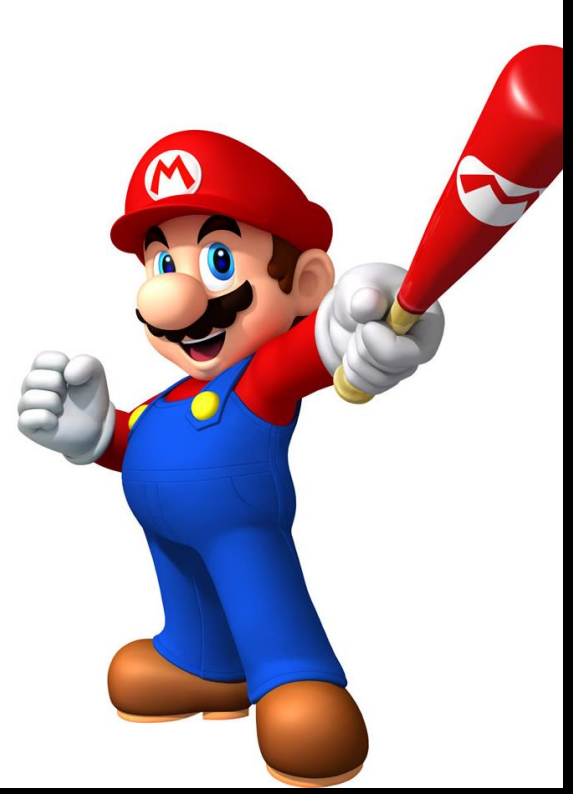
$$\text{Young VORPP} = 6{,}117 + 5.97(781) = 10{,}780.$$

- VORPP Used to Determine Salary

$$\text{Pujols 2006 value} = 22{,}848 \times 1{,}040 = \$23.8 \text{ million}.$$
$$\text{Hoffman 2006 value} = 9{,}485 \times 1{,}040 = \$9.9 \text{ million}.$$
$$\text{Young 2006 value} = 10{,}780 \times 1{,}040 = \$11.1 \text{ million}.$$

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

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



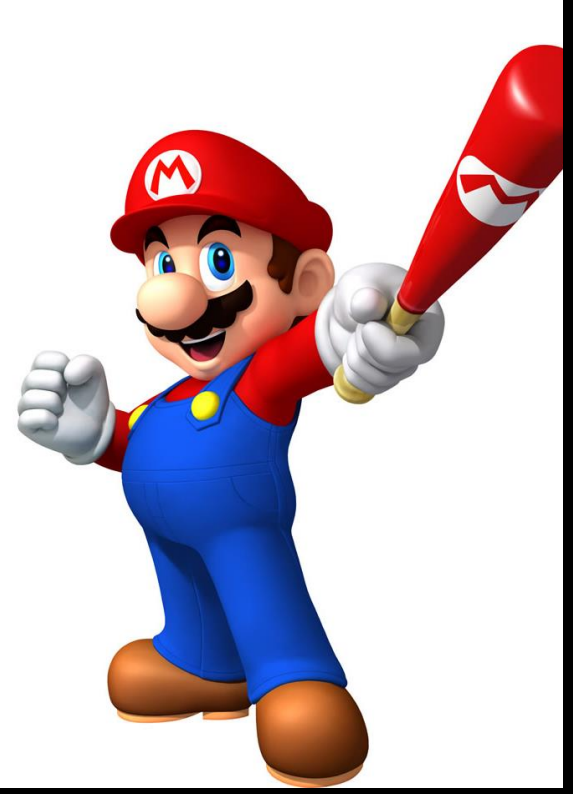
Value of Replacement Players

- 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

$$\$19.33M \times 1.05 \times 10 \approx \$202M$$



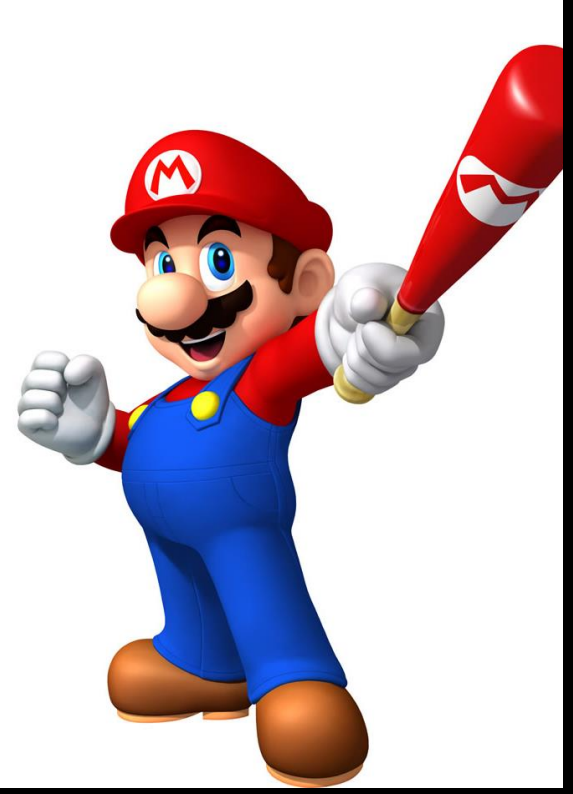
Value of Replacement Players

- Extra Plate Appearances Create Value

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

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

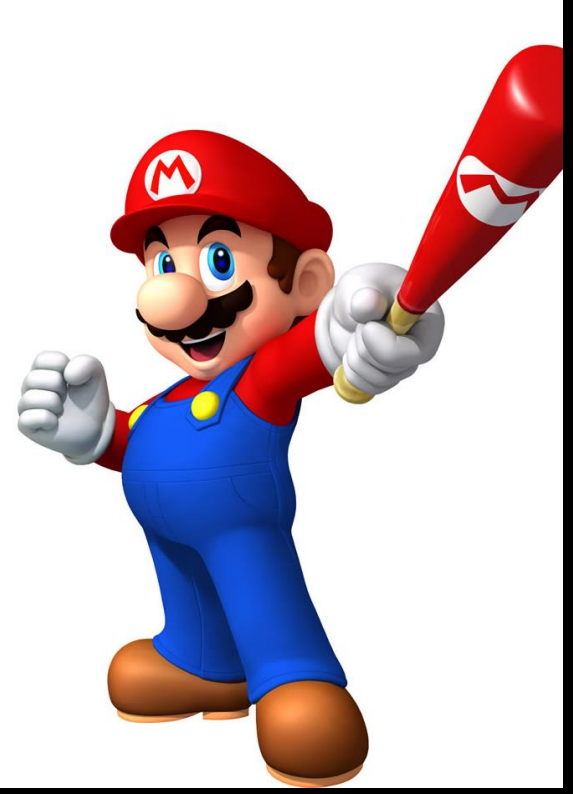
- VORPP Used by Theo Epstein in 2004 Red Sox Season



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?

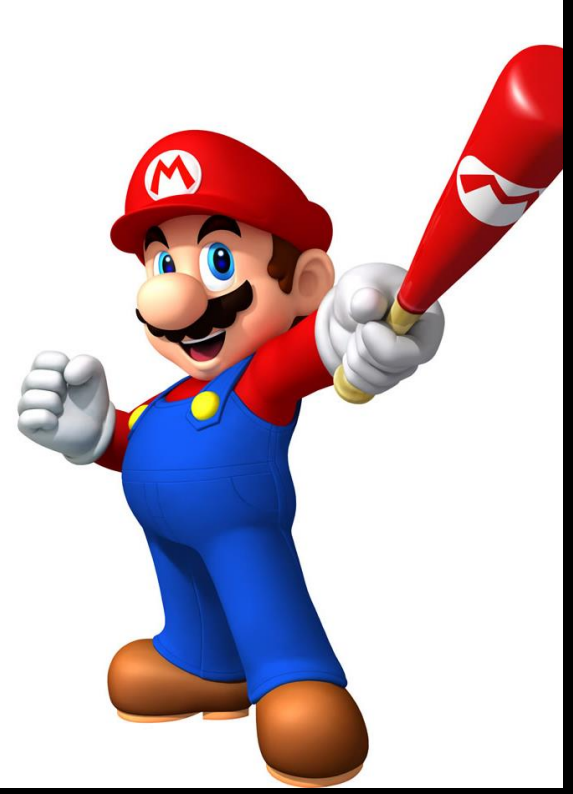
- Three Main Sources of WAR
  - Baseball-Reference (bWAR)
  - FanGraphs (fWAR)
  - Baseball Prospectus (WARP)



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)

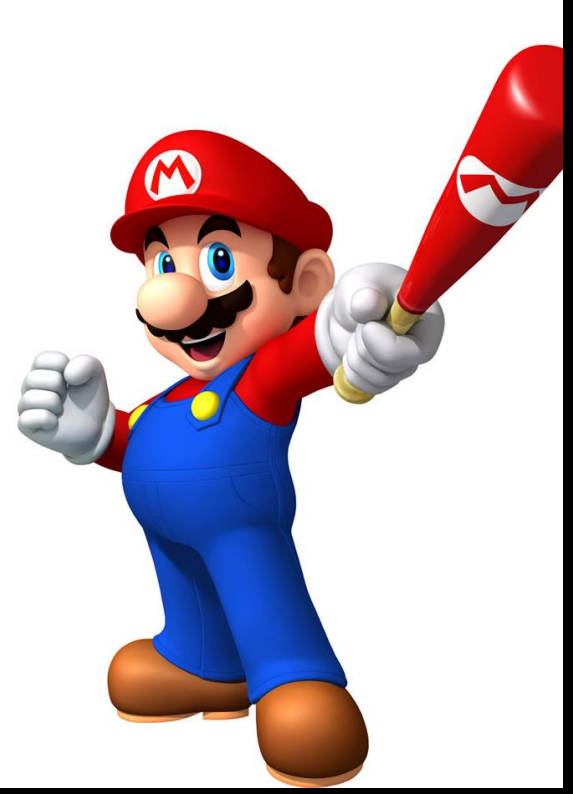
$$WAR = (Batting\ Runs + Base\ Running\ Runs + Fielding\ Runs + Positional\ Adjustment + League\ Adjustment + Replacement\ Runs) / (Runs\ Per\ Win)$$



Wins Above Replacement

- Top Players for bWAR Based on Career

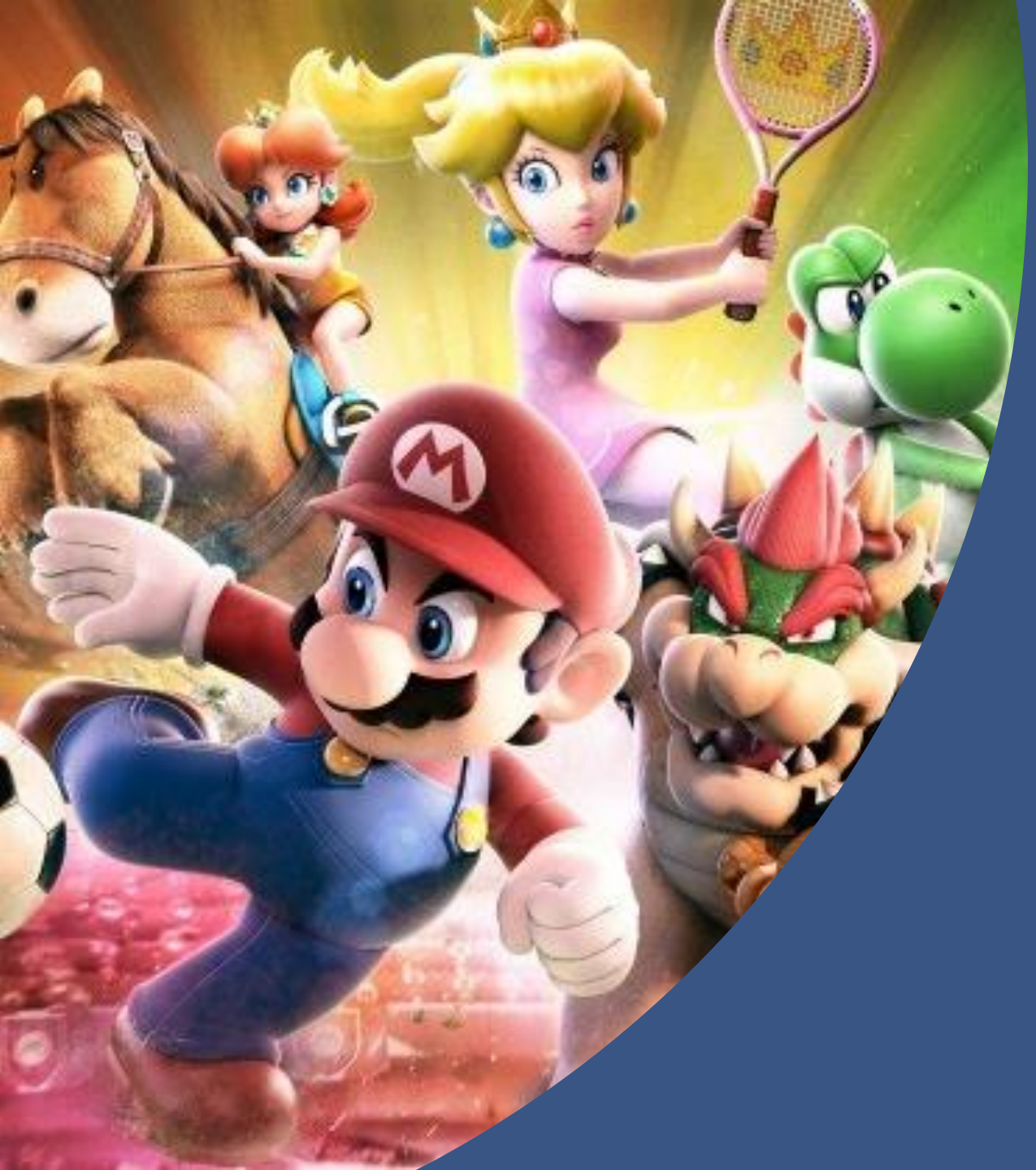
Rank	Player (yrs, age)	WAR Position Players	Bats
1.	Barry Bonds (22)	162.8	L
2.	Babe Ruth+ (22)	162.1	L
3.	Willie Mays+ (22)	156.4	R
4.	Ty Cobb+ (24)	151.0	L
5.	Hank Aaron+ (23)	143.0	R
6.	Tris Speaker+ (22)	134.1	L
7.	Honus Wagner+ (21)	130.8	R
8.	Stan Musial+ (22)	128.2	L
9.	Rogers Hornsby+ (23)	127.0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