Sabermetrics: An Introduction to Leveraging Baseball Metrics and Analysis to Enhance Team Performance

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BRANDEIS INTERNATIONAL BUSINESS SCHOOL

Overview

- Created in 1980 by Bill James, sabermetrics was titled “the search for objective knowledge about baseball”
- The group SABR was organized as a platform for baseball enthusiasts to study the integration of statistical analysis in baseball
- Goal: evaluating the sport as accurately as possible using different metrics as measurements for player performance and team outcomes
- Instead of using basic metrics such as batting average, Sabermetrics implements advanced statistics to better measure the impact a player or team decision has on the game

Traditional Metrics

Offense

- Batting average (AVG)
- On-base percentage (OBP)
- Slugging percentage (SLG)
- On-base plus slugging (OPS)

Pitching

- Earned run average (ERA)
- Walks and hits per inning pitched (WHIP)
- Batting average against (BAA)

Defense

- Fielding percentage (FPCT)

Overview of Sabermetrics Statistics

Weighted on-base average (wOBA)	Weighted runs above average (wRAA)	Weighted runs created plus (wRC+)	Batting average on balls in play (BABIP)
Defensive statistics (DRS/UZR)	Fielding independent pitching (FIP)	Wins above replacement (WAR)	Runs & wins

Weighted On-Base Average (wOBA)

- Combines different aspects of hitting into one metric
- Each aspect is weighted depending on their actual run value
- Explains how well a player contributes to run scoring
- Similar to OPS
  - OPS: OBP + SLG → how well a hitter can reach base + how well he can hit for average & power
    - Undervalues getting on base relative to hitting for extra bases

$$wOBA = \frac{.69 \times uBB - .72 \times HBP + .89 \times 1B + 1.27 \times 2B + 1.62 \times 3B + 2.1 \times HR}{AB + BB - IBB + SF + HBP}$$

Weighted Runs Above Average (wRAA)

- Measures the number of runs a player contributes compared to the average player
- Positive wRAA = above-average performance, negative wRAA = below-average performance
- Derived from wOBA

$$wRAA = \frac{wOBA - \text{league } wOBA}{wOBA} \times \text{PA}$$

Weighted Runs Created Plus (wRC+)

- Similar statistic to wOBA but takes into account park factors and the league run-scoring environment
- Created to quantify a player's total offensive value measured by runs
- Ability to compare players who played in different years, parks, and leagues

$$wRC = \left(\frac{wOBA - \text{league } wOBA}{wOBA \text{ scale}} + \text{league R/PA}\right) \times \text{PA}$$

$$wRC+ = \frac{\left(\frac{wRAA}{PA} + \text{league R/PA}\right) + (\text{league R/PA} - \text{park factor} \times \text{league R/PA})}{\text{AL or NL } wRC/PA \text{ exclusing pitchers}} \times 100$$

Batting Average on Balls In Play (BABIP)

- Comparative measure of how often non-home run 'balls in play' are hits
  - Requires large sample size
- Deviations between a player's AVG and BABIP are explained by luck or defensive performance
- Factors that influence BABIP:
  - Defense
  - Luck
  - Talent level
- Useful for pitchers too: pitchers have no control over what happens when a ball is hit in play
  - High pitcher BABIP → poor defense/bad luck

$$BABIP = \frac{H - HR}{AB - K - HR + SF}$$

Defensive Statistics

DEFENSIVE RUNS SAVED (DRS)

- Measures players by runs above or below average
- Components:
  - Stolen base runs saved (pitchers & catchers)
  - Bunt runs saved (1B/3B)
  - Double play runs saved (2B/SS)
  - Outfield arms runs saved (OF)
  - Home run saving catch runs (OF)
  - Plus minus runs saved

ULTIMATE ZONE RATING (UZR)

- Assigns a run value to defense, quantifying how many runs a player saves or gave up
- Components:
  - Outfield arm runs: runs above average an outfielder saves by preventing runners from advancing
  - Double-play runs: runs above average an infielder is by turning double-plays
  - Range runs: runs a fielder saves by getting to more balls than average
  - Error runs: errors committed by a fielder compared to league-average fielder

Fielding Independent Pitching (FIP)

- FIP estimates a pitcher's run prevention outside of defensive performance
  - Measures what a pitcher's ERA would be if the pitcher experienced league average results on balls in play
  - Dependent on outcomes that do not involve luck
    - Strikeouts, walks, hit batters, home runs

$$FIP = \frac{13 \times HR + 3 \times (BB + HBP) - 2 \times K}{IP} + \text{FIP constant}$$

Wins Above Replacement (WAR)

- Estimated all-inclusive total value of a player relative to a free available player
- Goal: provide a holistic value of a player
  - Enables comparisons across teams and years
- Position players:

$$WAR = \frac{\text{batting runs} + \text{baserunning runs} + \text{fielding runs} + \text{positional adjustment} + \text{league adjustment} + \text{replacement runs}}{\text{runs per win}}$$

- Pitchers:

$$WAR = \left(\left(\left(\left(\frac{\text{league FIP} - \text{FIP}}{\text{pitcher specific runs per win}}\right) + \text{replacement level}\right) \times \left(\frac{\text{IP}}{9}\right)\right) \times \text{reliever leverage multiplier}\right) + \text{league correction}$$

Comparing Players

ANTHONY VOLPE (SS, NYY)

- AVG/OBP/SLG: .243/.293/.364
- wOBA: .287
- wRC+: 87
- BABIP: .257
- WAR: 3.5

XANDER BOGAERTS (SS, SDP)

- AVG/OBP/SLG: .264/.307/.381
- wOBA: .300
- wRC+: 95
- BABIP: .297
- WAR: 2.0

Comparing Players Cont.

VICTOR ROBLES (OF, SEA)

- AVG/OBP/SLG: .307/.381/.433
- Average exit velocity: 86.7 mph
- Hard hit: 28.6%
- BABIP: .370
- xBA: .257
- xwOBA: .326
- WAR: 3.1

ONEIL CRUZ (UTIL, PIT)

- AVG/OBP/SLG: .259/.324/.449
- Average exit velocity: 95.5 mph
- Hard hit: 54.9%
- BABIP: .347
- xBA: .267
- xwOBA: .340
- WAR: 3.5

Run & Win Expectancy: Predicting Game Outcomes

References

- https://sabr.org/sabermetrics
- https://library.fangraphs.com/getting-started/
- https://www.mlb.com/glossary/standard-stats