

On base percentage

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In [baseball statistics](#), **on-base percentage (OBP)** (sometimes referred to as **on-base average [OBA]**, as the statistic is rarely presented as a true [percentage](#)) is a measure of how often a [batter](#) reaches base for any reason other than a [fielding error](#), [fielder's choice](#), [fielder's obstruction](#), or [catcher's interference](#) (the latter two are ignored as either [times-on-base \(TOB\)](#) or [plate appearances](#) in calculating OBP). OBP is added to [slugging average](#) to determine [on-base plus slugging](#) (OPS). It first became an official [MLB](#) statistic in [1984](#).

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[\[edit\]](#) Overview

Traditionally, the best leadoff hitters in the game have high on-base percentages. The league average for on-base percentage has varied considerably over time; in the modern era it is around .340, whereas it was typically only .300 in the [dead-ball era](#). On-base percentage can also vary quite considerably from player to player. The record for the highest career OBP by a hitter, based on over 3000 [plate appearances](#), is .481 by [Ted Williams](#). The lowest is by [Bill Bergen](#), who had an OBP of .194.

Though extremely unlikely, it is possible for a player's on-base percentage to be lower than his [batting average](#) (H/AB). However very few players in major league history fall into this category, with the majority of them having under 100 ABs, as it requires having almost no [walks](#) or times [hit by pitch](#), with a relatively higher number of [sacrifice flies](#) (e.g. if a player has 2 hits in 6 at bats with a sacrifice fly, his batting average would be .333, but his on-base percentage would be .286).

On-base percentage is calculated using this formula:

$$OBP = \frac{H + BB + HBP}{AB + BB + HBP + SF}$$

where

- H = [Hits](#)

- *BB* = [Bases on Balls \(aka Walks\)](#)
- *HBP* = times [Hit By a Pitch](#)
- *AB* = [At bats](#)
- *SF* = [Sacrifice Flies](#)

NOTE: Sacrifice flies were not counted as an official statistic until [1954](#). Before that time, all sacrifices were counted as [sacrifice hits](#) (SH), which included both sacrifice flies and [bunts](#). Bunts (sacrifice hits since 1954), which would lower a batter's on-base percentage, are not included in the calculation for on-base percentage, as bunting is an offensive strategy – often dictated by the manager – the use of which does not necessarily reflect on the batter's ability and should not be used to penalize him. For calculations of OBP before 1954, or where sacrifice flies are not explicitly listed, the number of sacrifice flies should be assumed to be zero.

[\[edit\]](#) All-time leaders

#	Player	OBP ^[1]	Team(s)	Year(s)
1	Ted Williams	.4817	Boston Red Sox	1939–1960
2	Babe Ruth	.4740	Boston Red Sox , New York Yankees , Boston Braves	1914–1935
3	John McGraw	.4657	Baltimore Orioles , St. Louis Cardinals , New York Giants	1891–1906
4	Billy Hamilton	.4552	Kansas City Cowboys , Philadelphia Phillies , Boston Beaneaters	1888–1901
5	Lou Gehrig	.4474	New York Yankees	1923–1939
6	Barry Bonds	.4446	Pittsburgh Pirates , San Francisco Giants	1986–2007
7	Bill Joyce	.4349	Brooklyn Ward's Wonders , Boston Reds , Brooklyn Grooms , Washington Senators , New York Giants	1890–1898
8	Rogers Hornsby	.4337	St. Louis Cardinals , New York Giants , Boston Braves , Chicago Cubs , St. Louis Browns	1915–1937
9	Ty Cobb	.4330	Detroit Tigers , Philadelphia Athletics	1905–1928
10	Todd Helton	.4291	Colorado Rockies	1997–2007

Slugging percentage

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[Barry Bonds](#) holds the [MLB](#) single-season **slugging percentage** record (.863).

$$SLG = \frac{TB}{AB}$$

In [baseball statistics](#), **slugging percentage** (abbreviated **SLG**) is the most popular measure of the power of a [hitter](#). It is calculated as [total bases](#) divided by [at bats](#):

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

where *AB* is the number of at-bats for a given player, and *1B*, *2B*, *3B*, and *HR* are the number of [singles](#), [doubles](#), [triples](#), and [home runs](#), respectively. Walks are specifically excluded from this calculation.

For example, in 1920, [Babe Ruth](#) played his first season for the [New York Yankees](#). In 458 at bats, Ruth had 172 hits, comprising 73 singles, 36 doubles, 9 triples, and 54 home runs, which brings the total base count to $73 + (36 \times 2) + (9 \times 3) + (54 \times 4) = 388$. His total number of bases (388) divided by his total at-bats (458) is .847, his slugging percentage for the season. The next year he slugged .846, and these records went unbroken until [2001](#), when [Barry Bonds](#) achieved 411 bases in 476 at-bats, bringing his slugging percentage to .863, unmatched since.

Although the term "slugging percentage" is used officially by [Major League Baseball](#), [SABR](#), and many sports media outlets, this is actually incorrect as the formula provides an [average](#), not a [percentage](#).

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[\[edit\]](#) Significance

Long after it was first invented, slugging percentage gained new significance when baseball analysts realized that it combined with [on-base percentage](#) (OBP) to form a very good measure of a player's overall offensive production (in fact, OBP + SLG was originally referred to as "production" by baseball writer and statistician [Bill James](#)). A predecessor metric was developed by [Branch Rickey](#) in 1954. Rickey, in *Life Magazine*, suggested that combining OBP with what he called "extra base power" (EBP) would give a better indicator of player performance than typical [Triple Crown](#) stats. EBP was a predecessor to slugging percentage.^[1]

[Allen Barra](#) and [George Ignatin](#) were early adopters in combining the two modern-day statistics, multiplying them together to form what is now known as "SLOB" (Slugging × On-Base)^[2]. [Bill James](#) applied this principle to his [runs created](#) formula several years later (and perhaps independently), essentially multiplying SLOB × At-Bats to create the formula:

$$RC = \frac{(Hits + Walks)(Total Bases)}{AtBats + Walks}$$

In 1984, [Pete Palmer](#) and [John Thorn](#) developed perhaps the most widespread means of combining slugging and on-base percentage: [OPS](#). "OPS" simply stands for "on-base plus slugging", and is a simple addition of the two values. Because it is easy to calculate, OPS has been used with increased frequency in recent years as a shorthand form to evaluate contributions as a [batter](#).

[\[edit\]](#) Perfect slugging percentage

The maximum numerically possible slugging percentage is 4.000, which has been achieved momentarily by several players who hit a home run on their first at-bat of the season. [Kevin Kouzmanoff](#), then playing for the [Cleveland Indians](#), hit a grand slam off of [Edinson Volquez](#) on his first major-league pitch on [September 2, 2006](#). He thus briefly achieved the best possible offensive percentage in every category, including some esoteric categories such as "runs per pitch" (4.000).

Earned run average

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$$\text{ERA} = 9 \cdot \frac{\text{ER}}{\text{IP}}$$

In [baseball statistics](#), **earned run average** (**ERA**) is the [mean](#) of [earned runs](#) given up by a [pitcher](#) per nine [innings pitched](#). The ERA tells the average number of runs a pitcher would inadvertently surrender over the course of a full game had he been kept in. It bears similar meaning to a hitter's [batting average](#). It is determined by dividing the number of earned runs allowed by the number of innings pitched and multiplying by nine. Runners reaching base on errors (even errors by pitchers) do not count toward ERA if they later score. To a pitcher, a lower earned run average is preferable to a higher one.

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[\[edit\]](#) Origins

[Henry Chadwick](#) is credited with first devising the statistic, which caught on as a measure of pitching effectiveness after [relief pitching](#) came into vogue in the [1900s](#). Prior to 1900 — and, in fact, for many years afterward — pitchers were routinely expected to pitch a [complete game](#), and their [won-loss record](#) was considered sufficient in determining their effectiveness. After pitchers like [James Otis Crandall](#) and Charlie Hall made names for themselves as relief specialists, gauging a pitcher's effectiveness became more difficult using the traditional method of tabulating wins and losses. The [National League](#) first kept official earned run average statistics in [1912](#) (the statistic was called *Heydler's Statistic* for a while, after then-NL secretary [John Heydler](#)), with the [American League](#) following suit afterward.

Modern-day baseball encyclopedias notate ERAs for earlier years, but these were computed many years after the actual accomplishments. [Negro League](#) pitchers are often rated by *RA*, or total runs allowed, since the statistics available for Negro League games did not always distinguish between earned and unearned runs.

[edit] ERA and baseball era

As with [batting average](#), the value of a good ERA varies from year to year. In the [1910s](#), a good ERA was below 2.00 (two earned runs allowed per nine innings). In the late [1920s](#) and [1930s](#), when conditions of the game changed in a way that strongly favored hitters, a good ERA was below 4.00; only a pitcher of the caliber of [Dazzy Vance](#) or [Lefty Grove](#) would consistently post an ERA under 3.00 during those years. In the [1960s](#), sub-2.00 ERAs returned as ballparks with different dimensions were introduced, among other influences. Today, an ERA under 4.00 is again considered very good, although pitchers such as [Greg Maddux](#) and [Pedro Martínez](#) stand out as Grove and Vance did in their day.

The all-time single-season record for lowest ERA in a season is 0.86, set by [Tim Lincecum](#) in [1980](#). The modern record is 0.96, set by [Dutch Leonard](#) in [1914](#). The lowest single-season ERA of an active pitcher is 1.12, achieved by [Bob Gibson](#) in [1968](#). The career record is 1.82, held by [Ed Walsh](#), and the active player with the lowest career ERA (among those with more than 1,000 innings pitched, a threshold that filters out most relief pitchers) is Martínez, with an ERA of 2.72 through the [2005](#) season. [Mariano Rivera](#) (career ERA of 2.29 through the end of the 2006 season) finished the 2006 season with 881 2/3 innings pitched, and has a strong chance to finish with more than 1,000 innings lifetime, earning the right, in many fans' minds, to be considered on an equal footing with starters in debates involving the term "greatest pitcher".

Some sources may list players with undefined or infinite career ERAs. This can happen if a pitcher allows one or more earned runs without retiring a batter (usually in a single appearance). An undefined ERA occasionally occurs at the beginning of a baseball season. It is sometimes incorrectly displayed as zero or as the lowest ranking ERA when it is more akin to the highest.

In modern baseball, an ERA under 2.00 is considered exceptional and is rare. An ERA between 2.00 and 3.00 is also considered excellent and is only achieved by the best pitchers in the league. An ERA between 3.00 and 4.00 is better than average. An ERA between 4.00 and 5.00 is average; the majority of pitchers have an ERA in this range. An ERA above 5.00 is generally considered worse than average, and a pitcher with an ERA above 6.00 for a prolonged period of time is usually in danger of demotion to the [bullpen](#) or a lower league.

[edit] ERA for starters vs. relievers

It can be very misleading to judge relief pitchers solely on ERA, because they are charged only for runs scored by batters who reached base while batting against them. Thus, if a relief pitcher enters the game with his team leading by 1 run, 2 outs in the inning, and the bases loaded, then gives up a single which scores 2 runs, he is not charged with those runs. If he retires the next batter, his ERA for that game will be 0.00 despite having surrendered the lead. (He is likely recorded with a [blown save](#) in this situation.) Starting pitchers operate under the same rules but are almost never called upon to start pitching with runners already on base. In addition, relief pitchers know beforehand that they will only be pitching for a relatively short while, allowing them to throw each pitch with maximum energy, unlike starters who typically need to keep something in reserve in case they are called upon to pitch 7 or more innings. This freedom to use their maximum energy for a few innings, or even for just a few batters, helps relievers keep their ERAs down.

ERA, taken by itself, can also be misleading when trying to objectively judge [starting pitchers](#), though not to the extent seen with relief pitchers. The advent of the [designated hitter](#) rule in the American League in 1973 made the pitching environment significantly different—pitchers spending all or most of their careers in the AL have been at a disadvantage in maintaining low ERAs compared to National League pitchers who can often get an easy out facing the opposition's ninth batter (oddly, Martinez and Rivera, the ERA kings of the last decade or so, have been mostly active in the American League).

This discrepancy between the leagues also affects relievers, but not to the same degree, as they actually pitch to pitchers far less than do starters for a number of reasons, chiefly because relievers are usually active in later innings when [pinch hitters](#) tend to be used in the ninth spot. ERA is also affected somewhat by the park in which a pitcher's team plays half its games, as well as the tendencies of hometown official scorers to assign errors or base hits in plays that could be either.

For an extreme example, pitchers for the [Colorado Rockies](#) have historically faced many problems, all damaging to their ERAs. The combination of high altitude and a semi-arid climate found in [Denver](#) causes fly balls to travel up to 10% farther than at sea level. Denver's altitude and low humidity also reduce the ability of pitchers to throw effective breaking balls, due to both reduced air resistance and to difficulty in gripping very dry baseballs. Also, the fences at [Coors Field](#) are not far enough from home plate to compensate for the increased fly-ball distance. The field also has a relatively small amount of foul territory. These conditions have been countered to some extent since 2002 by the team's use of [humidors](#) to store baseballs before games. These difficult circumstances for Rockies pitchers may not adversely affect their won-lost records, since opposing pitchers must deal with the same problems. Indeed, hometown hurlers have some advantage in any given game since they are physically acclimated to the altitude and often develop techniques to mitigate the challenges of this ballpark. Still, conditions there tend to inflate Rockie ERAs relative to the rest of the league.

[[edit](#)] Sabermetric treatment of ERA

In modern baseball, [Sabermetrics](#) uses several [defense independent pitching statistics](#) including a [defense-Independent ERA](#) in an attempt to measure a pitcher's ability regardless of factors outside his control. Further, because of the dependence of ERA on factors over which a pitcher has little control, forecasting future ERAs on the basis of the past ERAs of a given pitcher is not very reliable and can be improved if analysts rely on other performance indicators such as strike out rates and walk rates. For example, this is the premise of [Nate Silver](#)'s forecasts of ERAs using his [PECOTA](#) system.^[1] Silver also developed a "quick" earned run average ([QuikERA or QERA](#)) to calculate an ERA from peripheral statistics including strikeouts, walks, and groundball percentage. Unlike [Peripheral ERA](#), it does not take into account [park effects](#).^[2]

[[edit](#)] All-time leaders

Rank	Player	ERA	Team(s)	Year(s)
1	Ed Walsh	1.82	Chicago (AL) , Boston (NL)	1904-17
2	Addie Joss	1.89	Cleveland	1902-

3	<u>A. G. Spalding</u>	2.04	<u>Boston (NA), Chicago (NL)</u>	<u>10</u> <u>1871-</u> <u>77</u>
4	<u>Mordecai Brown</u>	2.06	<u>St. Louis (NL), Chicago (NL), Cincinnati, Brooklyn (FL), St. Louis (FL), Chicago (FL), Chicago (NL)</u>	<u>1903-</u> <u>16</u>
5	<u>John Ward</u>	2.10	<u>Providence, New York (NL), Brooklyn (NL), New York (NL)</u>	<u>1878-</u> <u>94</u>