

**ID Number – 14579**

**Description of statistic** – In the sport of golf, 1-putt percentage (1-PP abbreviation used throughout) represents the percentage of holes for which the golfer made his / her first putt attempt on the hole. Calculated as total 1-putts / total holes played.

The stats page of PGA.com includes 1-PPs for all players with at least 50 rounds of golf on the PGA tour in 2015. 1-PP is a good statistic at measuring the quality of a golfer’s putting abilities. Although the statistic has certain limitations, (for example, 1-PP is also partially a function of how good a golfer’s approach shot is, that is how close to the hole a golfer puts the ball with their previous shot), a good 1-PP tends to accurately reflect the golfers who putt best on tour.

\*note, PGA.com does not indicate whether an adjustment is made to 1-PP for holes whereby a golfer “holes out” from off the green (doesn’t need to use the putter), nor does it mention whether a putt from “off the green” (when a putter is used in place of a chip / wedge club) counts as a putt. Both may affect 1-PP, the latter more likely than the former.

**Regression and standard deviation** – Regression to the mean has been performed. See R code. The population variance and standard deviation were calculated using the formula from class, using an iterative process that initializes the population variance at zero, and updates the

	observed_1PP	true_1PP
Jordan Spieth	44.3%	42.7%
Andrew Putnam	43.6%	41.9%
Phil Mickelson	43.4%	41.9%
Brendon Todd	43.0%	41.9%
Danny Lee	42.6%	41.8%
Jerry Kelly	43.0%	41.8%
Charles Howell III	35.0%	36.2%
Jim Renner	34.1%	36.0%
Lucas Glover	34.2%	35.8%
Alex Prugh	33.9%	35.6%
Jim Herman	33.6%	35.3%
J.J. Henry	32.8%	34.7%

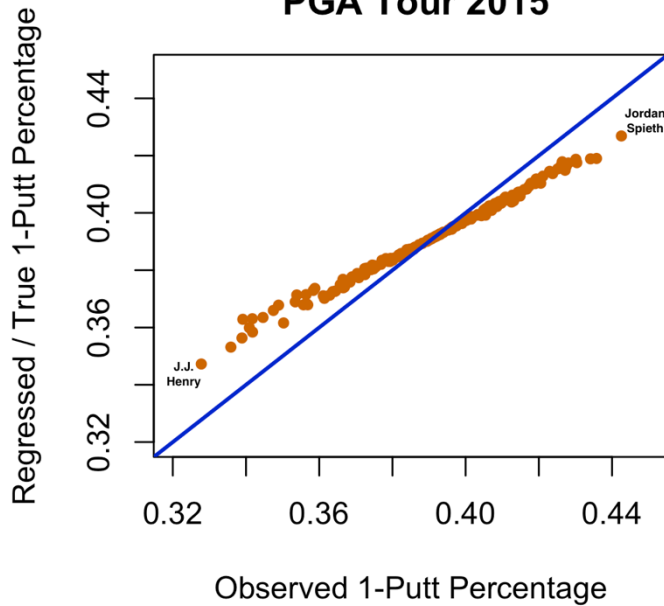
variance each iteration based on the previous estimate of the variance. The population standard deviation, calculated as the square root of the population variance, is 1.8%. An interpretation of 1.8% population standard deviation is that this is the approximate standard error of true 1-PP talent across all qualified PGA tour players.

As an example of its use, the population standard deviation can be used to create confidence intervals that estimate the distribution of 1-PP’s on the PGA tour. Using the mean 1-PP of 39.2%, and a rule of thumb 2 standard errors for a 95% confidence interval, we would estimate that 95% of golfers on the PGA tour have a 1-PP between

39.2% +/- 2\*1.8%, or (35.6% to 42.8%). This can be done with confidence intervals of any size.

\*note, the actual percentage of golfers within this range is 89.1%, not 95%, which hints that 1-PPs may not follow a Gaussian distribution, but rather follows a fatter-tail distribution. Note further that the table above shows the top and bottom 6 golfers by putt percentage, so specifically those golfers not likely to fall within the 95% confidence interval (ie. not a random sample of golfers on tour).

### True vs. Observed 1-Putt Percentage, PGA Tour 2015

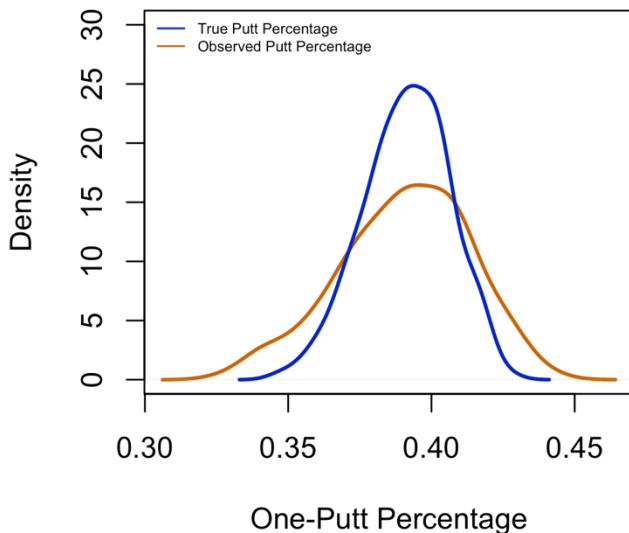


### Plot / Interpret Single (3) Athlete –

The scatterplot to the left highlights the effect of regression to the mean in order to estimate a golfer's true (or regressed) 1-PP, given their observed 1-PP. Using the  $y=x$  line as a reference, we can see that golfers with 1-PPs below the tour-mean are regressed towards the mean, and vice versa for golfers above the mean. Golfers with 1-PPs close to the tour-mean are not impacted much by regression to the mean. This effect is highlighted most using Jordan Spieth, who led the tour in 1-PP, and J.J. Henry, who was last in 1-PP amongst qualified golfers. Spieth's observed 1-PP was 44.3% and his true / regressed 1-PP was 42.7%, whereas Henry's

observed 1-PP was 32.7% and his true / regressed 1-PP was 34.73%. As a comparison, Justin Rose's 1-PP of 39.9% is slightly above but still close to the tour mean, and his true / regressed 1-PP of 39.6% is therefore very close to his observed 1-PP.

### Dist of 1-putt % on PGA tour, 2015



**Additional Plot –** the density plot to the left shows the distributions of observed 1-PP as well as true / regressed 1-PP.

These are PDFs of the distributions, so the area under each of these curves is 1, and the graphs give an indication of how concentrated the 1-PPs are. Notice that the true 1-PP distribution is more compact around the distribution's mean, which is expected as a result of regressing 1-PPs to the mean.