

# In or out? The new flagstick dilemma for putting in golf

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## Abstract

The United States Golf Association adopted rule changes in 2019 to simplify and speed up the game of golf. Before 2019, golfers were assessed a one-shot penalty if a putted ball made contact with the flagstick. Now under Rule 13.2(a), golfers have the option to either remove the flagstick or leave it in the hole without penalty when putting on a green. No consensus on the better strategy has emerged, even among professional golfers. The Edoardo Molinari Golf Academy recently performed an experiment to solve this dilemma, with its analysis relying solely on comparing the observed proportion of holed putts. The purpose of our presentation is to examine their data using statistical modeling and inference methods. With our analysis, we agree with their conclusion that it is better for the flagstick to be out for a ball approaching the hole at a medium speed. However, we do not necessarily agree with their conclusion that leaving the flagstick in is better for a ball approaching the hole at a fast speed. While the observed proportions suggest a possible benefit with leaving it in, the data does not provide sufficient evidence that this can be generalized beyond the sample.

## Experiment

- Performed by the Edoardo Molinari Golf Academy (Sources: Myers, *Golf Digest*, January 10, 2019; [www.instagram.com/p/Bsdkf1b1JPd](http://www.instagram.com/p/Bsdkf1b1JPd))
- Factors
  - Flagstick
    - Out
    - In
  - Entry line of ball as it approaches the hole relative to flagstick location
    - Center – Ball would hit the middle of the flagstick
    - Slightly off-center – Ball would hit the flagstick left/right of center
    - Grazing – Ball would barely touch the flagstick left/right of center
  - Ball speed relative to hole if the flagstick was not there
    - Low – Ball would land in bottom of the hole
    - Medium – Ball would hit back of the hole below the rim
    - High – Ball would bounce up into the air upon reaching the hole
- Entry line and ball speed were controlled by using a Perfect Putter
  - A Perfect Putter is a ramp used to set the ball into motion toward the hole
  - Ball is started at different heights on the ramp to control its speed
- 100 trials for each factor-level combination

## Observed data

- Observed proportion of successful putts for **flagstick out**, **flagstick in**

		Ball speed at the hole		
		Low	Medium	High
Entry line at the hole	Center	100%, 100%	100%, 100%	81%, 100%
	Slightly off-center	100%, 100%	73%, 45%	0%, 7%
	Grazing	100%, 100%	38%, 14%	0%, 0%

- Understanding the table:
  - For putts grazing the flagstick, 38 out of 100 (38%) were successful with the flagstick out
  - For putts grazing the flagstick, 14 out of 100 (14%) were successful with the flagstick in
- The Edoardo Molinari Golf Academy concluded
  - Taking the flagstick out of the hole is better for off-center putts reaching the hole at a medium speed
  - Leaving the flagstick in is better for center or slightly-off center putts reaching the hole at a high speed

## Purpose

- Conclusions reached by the academy were made without taking into account experimental variability
- The purpose of my research is use statistical inference procedures to re-examine the data

*Pin in, is an easy one. It's statistically proven to be a benefit in 99 percent of situations ... Anything outside 10 feet I'm going to leave it [flagstick] in. If I accidentally hit it [ball] three feet instead of two feet past the flag, it [ball] will stay in the cup. It [ball] has a better potential of staying in the cup than with it [flagstick] out.*

– Bryson DeChambeau, Dubai Desert Classic, January 2019

DeChambeau putting at the Sentry Tournament of Champions in January 2019: The ball approaches the hole at a medium speed (likely would hit the back of the hole without the flagstick in) and is slightly off-center relative to the flagstick



Source: PGA Tour channel on YouTube ([youtu.be/e1NUSszeZas?t=13](https://youtu.be/e1NUSszeZas?t=13))

Does the ball go in the hole?



## Analysis #1

- Confidence intervals for difference in probability of success (Out - In)
  - Score confidence intervals (Agresti et al., 2008; Chapter 1 of Bilder and Loughin, 2014)
  - Bonferroni corrections are used to control familywise error rate at a level of 95% or higher

		Ball speed at the hole		
		Low	Medium	High
Entry line at the hole	Center	(-0.07, 0.07)	(-0.07, 0.07)	(-0.32, -0.11)
	Slightly off-center	(-0.07, 0.07)	(0.09, 0.45)	(-0.18, 0.00)
	Grazing	(-0.07, 0.07)	(0.07, 0.40)	(-0.07, 0.07)

- Flagstick effect conclusions are similar to those of the academy
  - However, the evidence for high speed and slightly off-center putts is not necessarily strong due to the interval containing 0
  - Agresti and Caffo's (2000) add 2 successes/failures and Fay et al.'s (2015) exact intervals also include 0 within their intervals for those factor level combinations

## Analysis #2

- A logistic regression model is developed to estimate the probability of success by taking into account the three factors
  - Standard methods cannot be applied directly due to the 100% and 0% success proportions – add/subtract 0.5 counts to the 0%/100% table cells, respectively
  - Examined categorical and ordinal variable types for ball speed and entry line – categorical variable types resulted in much better fitting models
- Best model included
  - Main effects: flagstick, entry line, ball speed
  - Interaction: flagstick and ball speed
- Odds ratios comparing flagstick out vs. flagstick in
  - Maximum likelihood estimates and profile likelihood ratio confidence intervals
  - Bonferroni corrections are used to control familywise error rate at a level of 95% or higher

		Ball speed at the hole		
		Low	Medium	High
Estimate		1.00	3.45	0.10
Confidence interval		(0.03, 39.07)	(1.91, 6.38)	(0.01, 0.37)

- Example odds ratio interpretation: For putts approaching the hole at a medium speed, the estimated odds of a successful putt are 3.45 times as large when the flagstick is out than when the flagstick is in, holding the entry line constant
- Model-based estimates of difference in probability of success (Out - In)
  - Wald confidence intervals with delta-method approximations for standard errors
  - Bonferroni corrections are used to control familywise error rate at a level of 95% or higher

		Ball speed at the hole		
		Low	Medium	High
Entry line at the hole	Center	(0.00, 0.00)*	(-0.00, 0.00)*	(-0.28, -0.06)
	Slightly off-center	(-0.01, 0.01)*	(0.15, 0.43)	(-0.13, -0.01)
	Grazing	(-0.04, 0.04)*	(0.11, 0.34)	(-0.03, 0.00)

- \*Due to the 100% success rates for flagstick in/out and the delta-method approximations, the quality of these intervals is questionable
- Similar interpretations as for Analysis #1

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