THE STATISTICS AND ECONOMICS OF MORE SUSTAINABLE GOLF COURSE DESIGN

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Introduction

Technological improvement in golf equipment design means golfers can hit the ball longer and straighter, making many golf courses – even Augusta National – "too easy." (Beaton, 2022) Even at amateur levels, improved equipment can reduce the difficulty of a particular hole, especially when coupled with players using forward tees. Many facilities have responded by lengthening holes, resulting in larger, longer courses that are more expensive and environmentally intensive. We argue that in response to technological improvement, golf courses should pursue other adaptations. Using the PGA's Strokes Gained data, we show that adjustments to hole difficulty can be as effectively achieved via modification to fairway width, penalty areas, and green size as via adding length. The specific details of how to best redesign any particular hole can be modified for the local geographical features of the course. The modifications we examine will also aid courses in achieving positive sustainability outcomes, and may also connect courses to new revenue streams. We offer a quantitative approach to estimating the scoring impacts of design modifications, in turn helping courses better understand implications of renovation.

Methods

We conduct a Monte Carlo simulation to demonstrate how alternatives to lengthening can change the difficulty of a golf hole. Our analysis relies on the use of the extensive PGA Strokes Gained data, following Broadie (2014), building on data on the average number of strokes to hole out from various distances and various lies. Following Broadie (2008), we assume that golfers aim at the middle of the fairway and have a symmetrical shot pattern with a "directional error" mathematically represented by the standard deviation of the angle between the aim and shot. We construct simulated holes and estimate the average number of strokes to hole out given various types of modification, and compare these to modifying by length alone.

Results and Discussion

Our analysis shows that any golf hole can be made more difficult through modification to fairway width, penalty areas, and green size and that these modifications are score-equivalent to simply adding length. Figure 1 provides a visual summary of our approach and main findings. This is a valuable finding for three reasons. First, narrower and/or more penal holes can reduce renovation and/or maintenance costs. Second, the modifications we outline open the door to a wider variety of clubs attracting and retaining users ranging from elite professionals and scratch amateurs to men, women, elderly, and young players of all skills and abilities. Third, the modifications we outline are an "on ramp" to improving courses' sustainability impacts, particularly in areas of water management, biodiversity/habitat restoration, and climate change issues.

Significance

Golf has experienced a boom in popularity in recent years. As many embrace (or return to) the game, courses will be expected to continuously provide new challenges suitable for a wide range of ages and skills. Our research shows that focusing on length alone is not at all necessary to provide additional difficulty. An approach to modification that eschews length in favor of width, penalty area, and green size means that a greater number of courses can achieve "championship" levels of difficulty. Also, courses without this particular ambition can think more creatively about renovation to better serve older, younger, skilled, and novice golfers alike with holes that are challenging and fun, in a way that results in lower costs and enhanced sustainability impacts.

References

Beaton, A. "The 8,000-yard problem looming over The Masters." *The Wall Street Journal*, 04/06/2022; **Broadie, M**. *Every shot counts…* Random House, New York, 2014; **Broadie, M**. "Assessing golfer performance using Golfmetrics." *Science and Golf V: Proceedings of the 2008 World Scientific Congress of Golf*. Energy in Motion Inc. Mesa, AZ, 2008.

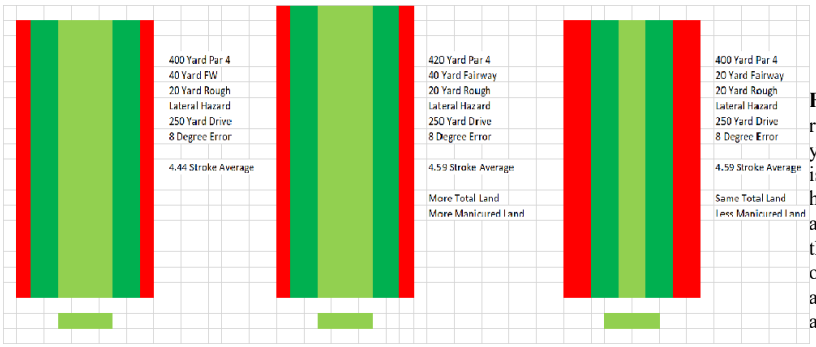

Figure 1. We consider a 400-yard par 4, which we model as a rectangle that is 400 yards long and 80 yards wide. The 40-yard wide fairway lies within the center of the rectangle and is surrounded by 20 yards of rough on each side. There is a hazard on the outside boundaries of the rough that we treat as a lateral hazard. If a player drives into the hazard, we assume the player hits their third shot from the rough at the boundary of the hazard. The player hits their drive 250 yards and the angle between the ball direction and fairway center line has an 8-degree standard deviation (Broadie 2008)