

## **A groovy kind of club: Examining the impact of new grooves rules on the PGATOUR**

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### **Abstract**

In January 2010, grooves on the heads of golf clubs were mandated to have less volume and rounder edges. The intention of the controversial new grooves design was to make hitting from the rough harder, thereby making driving accuracy more important. We analyze data from 2009 and 2010 to determine the impact of the new rule on golfers on the PGA TOUR. In the 1980's, those golfers who were ranked most accurate in their driving were also ranked highest on the money list. However, this correlation has steadily decreased, to the point where it is now nearly zero. We find that for 2010, the correlation between these two variables is higher, but not statistically significantly so. We then examine whether it was harder in 2010 to hit from the rough, both visually and statistically. Both approaches show that it was no more difficult to hit from the rough in 2010 than in 2009, and perhaps even easier. Lastly, we look into players' strategies to determine whether or not they are playing differently in 2010 to adjust for the new rule. We find no evidence - either visual or statistical - to suggest that players have significantly changed their styles in 2010.

## 1 Introduction

Many players and fans who love and follow golf consider the aim of the drive to be an important part of the game. Where the ball lands off the tee reflects how well a golfer aims ball on the drive, the first stroke of a golf hole. While many factors may determine the quality of the aim of the drive, the statistic watched most is Driving Accuracy (DA), which measures whether or not the ball landed on the fairway off the tee shot. Professional golfers may have a Driving Accuracy of around 70%, meaning that they hit the fairway 7 times out of 10 on par 4 and 5 holes.

Driving Accuracy has become less and less correlated with winning since the 1980's, prompting the United States Golf Association (USGA) to investigate ways to increase the importance of Driving Accuracy. Dick Rugge, the senior technical director at the USGA, stated last year "One of the key skill parameters in golf is driving accuracy ... And it was a very important predictor of scoring and winning in the 1980s. But that parameter dropped significantly between 1990 and 2003, to the point where there has been zero correlation between accuracy and winning during the last few years. ... We want to return to the parameters of the '80s and put more of a premium on accuracy." [1]

One hypothesis for the apparent decrease of importance of Driving Accuracy has been that the technical advancement of grooves on golf clubs has made hitting the ball from the rough much easier. Arnold Palmer told Dick Rugge that he thought the "biggest mistake the USGA ever made was letting square grooves in the game" [1], namely because if it is easier to hit out of the rough, then golfers have less motivation to avoid the rough. On the other hand, if hitting from the rough were more difficult, golfers with better accuracy (i.e., fewer shots in the rough) might be rewarded by winning more often.

In January of 2010, grooves on the clubs of professional golfers were mandated to have a different shape. Instead of being voluminous (thereby allowing grass and water to be channeled away efficiently) with sharp edges (gripping the ball and allowing for greater control), grooves had to be smaller with rounder edges.

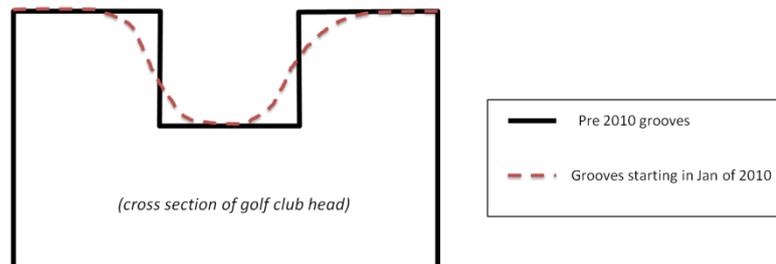


Figure 1: New grooves shape taking effect in January 2010 (A non-technical sketch)

In this paper, we investigate the impact the grooves rule change has had by answering three questions:

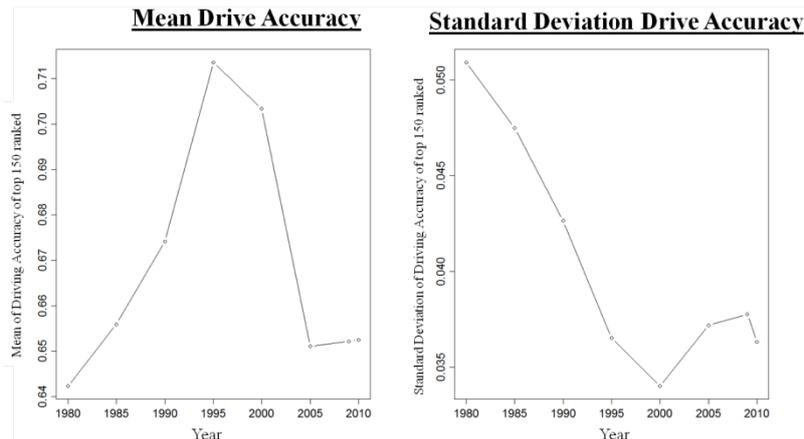
1. *Has the correlation between Driving Accuracy and winning increased?*
2. *Is it more difficult to hit the ball out of the rough?*
3. *Have players changed their strategies to compensate for the rule change?*

To answer these questions, we examine ShotLink data from 2009 and 2010 on thirty golf courses, as well as data on Driving Accuracy and winning. ShotLink data records the location of every shot on every PGA TOUR event, and is used with a special agreement with the PGA TOUR. Driving Accuracy data is recorded from the PGA TOUR website [2], while money list rankings and event finish rankings are based on the first 21 events of 2010.

For each of the above questions, we find that there is no evidence to suggest that the new grooves are having the intended effect. In section 2, we investigate the Driving Accuracy statistic and its correlation with winning. In section 3, we look at the difficulty of hitting the ball out of the rough, both pre- and post-grooves rule change. Lastly, we examine whether or not players are changing their style of play in section 4.

## 2 The Drive Accuracy Statistic

Driving Accuracy measures the percentage of time a golfer hits the fairway on the tee shot on par 4 and 5 holes. The best PGA TOUR golfers hit the fairway only about 3 out of 4 times, with the average over all golfers in recent years being about 2 out of 3. Over the past thirty years, the mean Driving Accuracy statistic has increased then decreased, while the "spread" of golfers' Driving Accuracy statistics (as measured by standard deviation) has decreased (See Figure 2).

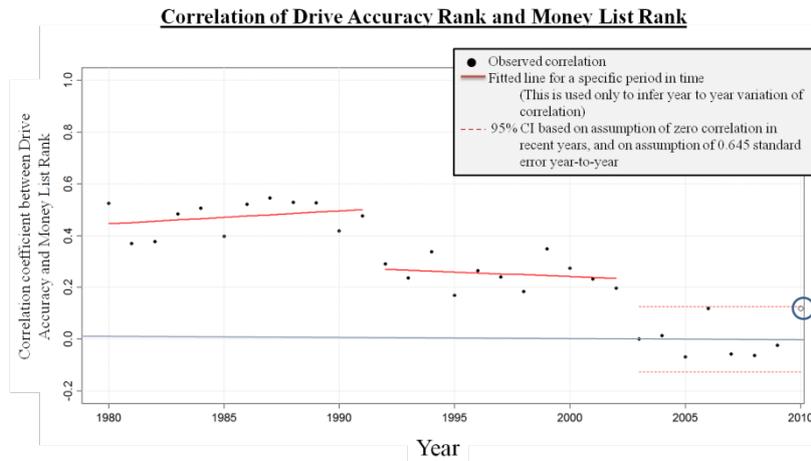


**Figure 2: Change in Driving Accuracy over the last 30 years, measured every 5 years. Each data point is the aggregation of the top 150 golfers for a given year.**

These plots show us that golfers today are driving about as accurate as they were in the early 1980's, but, surprisingly, they are more similar to each other today (i.e., the spread of Driving Accuracy among golfers has decreased). This lack of heterogeneity is one possible explanation for the decrease in correlation between winning and Driving Accuracy, which we examine next. The more similar golfers are to each other for a certain skill, the less important that skill is overall.

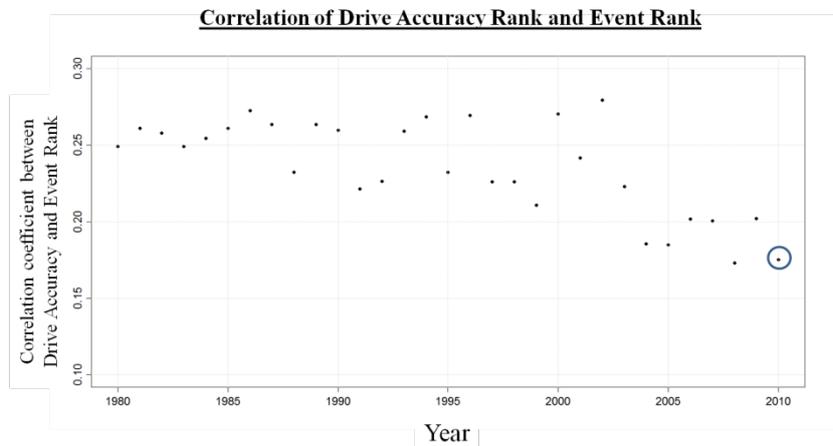
There are two ways winning is defined: winning lots of money and being near the top of the money list at the end of a season, or winning tournaments and ranking near the top of individual events' rankings. The money list is appealing because at the end of the day, it can be argued that golfers play for money, and therefore the rank on the money list is the ultimate determinant of "winning". On the other hand, purses for tournaments vary significantly, and golfers who place first in a tournament win a disproportionately large amount of the purse, leading to possibly noisy data. We investigate both approaches because of their prevalence in the golf community, and because of their role in the motivation of the rule change in the first place.

Figure 3 shows how the correlation between Driving Accuracy and Money List rank has decreased over the past 30 years, with three main eras defined. The golfer who earned the most money in a given year would have a rank of 1. Likewise, the golfer who hit the highest percentage of fairways would have a Driving Accuracy rank of 1 as well. The points on the plot correspond to the correlation coefficient between these rankings for each year. The data for 2010 is highlighted by a blue circle. We see that the correlation for 2010 increased, but also that this increase is not statistically significant at the 95% level. That is, the correlation coefficient for 2010 is within the expected variation we see from year to year of the correlation between Driving Accuracy Rank and Money List Rank.



**Figure 3: Correlation of Drive Accuracy Rank and Money List Rank**

Looking at a less noisy (due to the skew of the purse) determinant of winning, Event Finish Rank, we see the opposite result. A golfer who finishes first in a tournament has rank 1, while Driving Accuracy is defined as above except at the event level. Figure 4 shows how the correlation has also decreased over recent years, but not as significantly. In 2010, the correlation between Event Finish Rank and Driving Accuracy rank actually *decreased*, implying that aim off the tee was even less important in 2010 to winning events.



**Figure 4: Correlation of Drive Accuracy Rank and Event Finish Rank**

Looking at the correlation between Driving Accuracy and winning (where we look at winning defined two different ways), we find a lack of evidence to suggest that accuracy off the tee is more important after the grooves rule change than before.

### 3 Difficulty of Hitting Out of Rough

The intent of the new shape of the grooves was to make hitting out of the rough more difficult. In this section we show a lack of evidence to suggest that hitting out of the rough was more difficult in 2010 than in 2009. We examine the difficulty of the rough visually as well as statistically, both with similar conclusions.

Once the ball is in the rough, a "better" shot from this undesirable location will be A) closer to the hole, and B) on the green (or in the hole). If it is harder to play from the rough, we might expect that balls will be farther from the hole on shots from the rough, and that balls less often hit the green on shots from the rough. Figure 5 shows the mean distance remaining bucketed by starting distance in yards for 2009 and 2010. These plots are based on ShotLink data from thirty golf tournaments that were played in both years up to August of 2010. We see that in 2010, golfers actually ended up *closer* to the hole for starting distances between 150 and 300 yards, with no discernable difference for starting distances closer than 150 yards. This is counterintuitive, as we would have expected that if the rough were more difficult, we would end up *farther* from the hole.

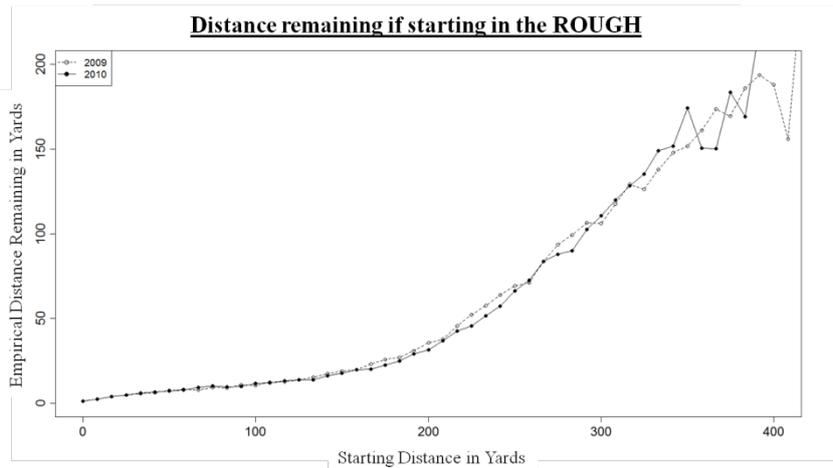


Figure 5: Distance Remaining vs. Starting Distance in 2009 and 2010 from the Rough

In Figure 6, we examine the empirical probability of hitting the green when starting from the rough. For each starting distance bucket, we measure the percentage of times shots from the rough ended up on the green. Again, from 150 to 300 yards, golfers actually hit the green *more* often in 2010 than in 2009, where we might have expected hitting the green to be more difficult from the rough after the rule change.

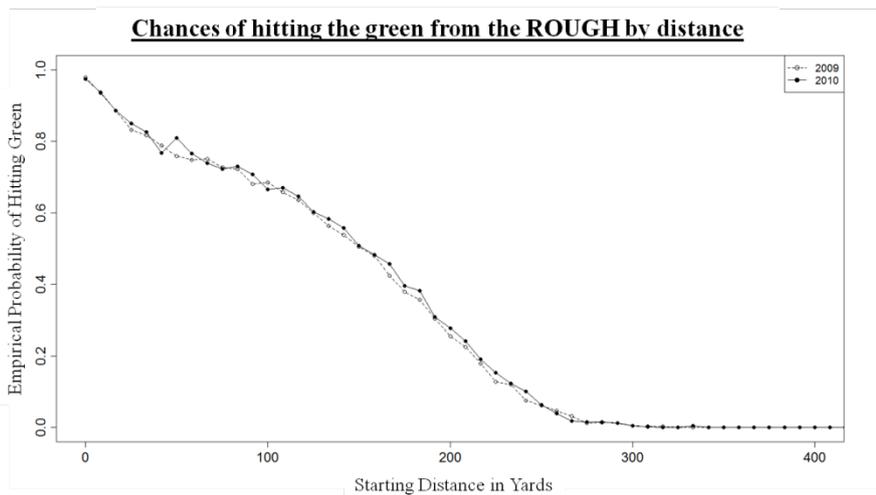


Figure 6: Empirical Probability of hitting the green vs. Starting Distance in 2009 and 2010 from the Rough

To examine rough difficulty more rigorously than by sight, we perform a linear regression on the data. In the regression, we evaluate hole score as a function of hole and day, player, distance to the pin from the tee, a 0/1 variable indicating whether or not the tee shot landed in the rough in 2009, and a 0/1 variable indicating whether or not the tee shot landed in the rough in 2010. The coefficients we are interested in

are the dummy variables for the rough, which are shown in Table 1, with the other factors being included to correct for hole difficulty and player skill. On average, landing in the rough adds about a quarter stroke to one's score. But, contrary to our intuition, the increase in score due to landing in the rough in 2009 was *more* than in 2010. If it were more difficult to play from the rough in 2010, we might have expected the coefficient to be higher in 2010. The difference in the coefficients is statistically significant.

| Independent variable                       | Coefficient value |
|--|-------------------|
| Did it land in rough on the drive in 2009? | <u>0.250</u> *    |
| Did it land in rough on the drive in 2010? | 0.236             |

**Table 1: Coefficients for Rough Dummy variables in the linear regression predicting hole score**

We find no evidence to suggest that the new grooves are making it more difficult to control the ball from the rough. In fact, both visually and statistically, we see that it was *easier* to play from the rough in 2010. These results, while contrary to the intent of the new rule, have been seen elsewhere, most notably by Broadie [3], who uses a shot value approach to answer a similar question.

## 4 Change in Player Styles

If golfers perceive that the rough is more difficult to play from, they may try harder to avoid it. This can show up in a variety of ways: more accurate drives, shorter drives, or more controlled drives. We investigate drive distance and drive control because we hypothesize that in order to hit the fairway more often, golfers might drive with less power so that they can aim better. We find no evidence to suggest that golfers changed their style of play once they started using clubs that conformed to the new grooves rule.

Table 2 shows that while the fraction of tee shots hitting the rough decreased, the increase was not practically significant. We saw in section 3 that hitting the rough added about a quarter stroke to one's hole score. Therefore, the decrease in fraction of drives hitting the rough of  $(0.249 - 0.242 = ) 0.007$  corresponds to about  $(0.007 * 18 * 0.25 = ) 0.03$  strokes per round, or about a tenth of a stroke per tournament. We did not find evidence to suggest that this change is a conscious effort on the part of the majority of PGA TOUR golfers to avoid the rough.

| Fraction of drives hitting the rough | 2009                | 2010         | Statistically Significantly Different? |
|--------------------------------------|---------------------|--------------|--|
| Par 3 holes                          | <u>0.148</u>        | 0.132        | Yes                                    |
| Par 4 holes                          | <u>0.281</u>        | 0.273        | Yes                                    |
| Par 5 holes                          | 0.269               | 0.275        | No                                     |
| <b>Par 4 and 5 holes</b>             | <b><u>0.278</u></b> | <b>0.274</b> | <b>Yes</b>                             |
| <b>All Holes</b>                     | <b><u>0.249</u></b> | <b>0.242</b> | <b>Yes</b>                             |

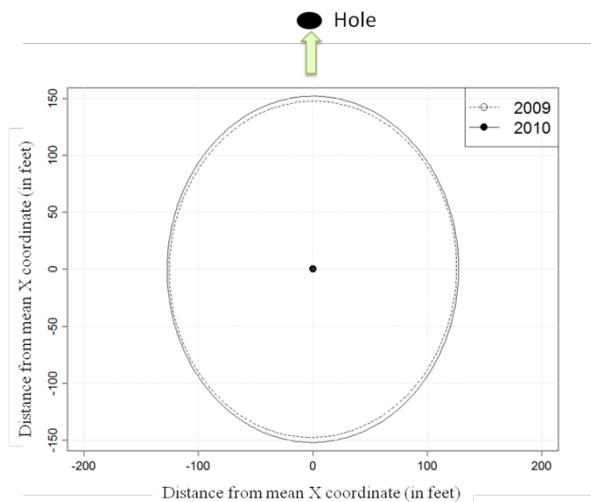
**Table 2: Fraction of shots off the tee hitting the rough. Underlined values are statistically significantly bigger.**

Table 3 shows the average drive distance for each year. We see that overall, drive distance *increased* in 2010, although not statistically (or practically) significantly so. Digging into par 5 vs par 4 holes, there is some evidence to suggest that on par 5 holes golfers are driving shorter distances in 2010, but this is paired with the fact that they are driving *longer* on par 4 holes. While this requires further looking into, the overall statistic shows no meaningful change in driving distance.

|                          | 2009             | 2010             | Statistically Significantly Different? |
|--------------------------|------------------|------------------|--|
| Par 4 holes              | 275.5 yds        | <u>276.1 yds</u> | Yes                                    |
| Par 5 holes              | <u>290.0 yds</u> | 288.5 yds        | Yes                                    |
| <b>Par 4 and 5 holes</b> | <b>278.7 yds</b> | <b>278.9 yds</b> | <b>No</b>                              |

**Table 3: Mean distance of drives. Underlined values are statistically significantly bigger.**

We hypothesize that drives in 2010 are more controlled. To test this hypothesis, we model the landing position of the ball off the tee as a bivariate normal distribution. For each hole, we calculate the covariance matrix of this distribution for 2009 and 2010. We then aggregate the data for all holes to obtain a covariance matrix for each entire year. Using this covariance matrix, we compare the 95% confidence ellipses between 2009 and 2010. If the hypothesis were correct, we would expect that the dispersion (or "spread") of tee shots in 2010 would be tighter, and that the 95% confidence ellipse for 2010 would be smaller. In Figure 7, we actually see the opposite: drives were *more* spread out in 2010 than in 2009.



**Figure 7: The 95% confidence ellipses aggregated among all drives in 2009 and 2010, assuming a bivariate normal distribution.**

The difference in the X and the Y directions is statistically significantly different between the years, using an F-test at the 5% level. However, this difference is in a direction opposite from what our hypothesis predicted. This, when taken together with the drive accuracy and distance empirical data suggests that there is not strong evidence to suggest that the majority of PGA TOUR golfers have significantly changed their style of play.

## 5 Conclusion

The grooves rule change of 2010 was motivated by a desire to increase the importance of Driving Accuracy. To achieve this, the USGA changed the shape of the grooves on golf clubs in an effort to make playing from the rough more difficult. The results of the years of research put into the project suggest that the change in the grooves shape *does* change the spin and control of the ball. However, this fact of physics is not being reflected in the data we looked at. Correlation between winning and Driving Accuracy has not increased, it is not more difficult to play from the rough, and golfers have not significantly changed their style of play to compensate for the rule change. But although we can say *that* we don't observe a change in playing from the rough in 2010, we cannot say *why* we don't observe this change. The ball is interacting with the clubs differently due to the new grooves, and yet, we have not observed the results of this change. As the 2010 season ends and a full year's worth of data becomes available, it will be interesting to dig even deeper into the data to try to answer this question of *why*. Additionally, it is worth investigating golfers' styles of play further. While there appeared to be no change in their aggregate play, there was some evidence to suggest that their style of play may have changed in certain situations (par 4 vs. par 5 holes, e.g.).

## 6 Acknowledgements

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## 7 References

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- [3] M. Brodie, "A Shot Value Approach to Assessing Golfer Performance on the PGA TOUR" *Working Paper*. May 3, 2010.