

# Club Decision Making Model

## 1. Summary

The impact of hole length and fairway width is believed to have a strong relationship with golfer drive distance. As part of the Distance Insights project, this relationship is looked at closely to explore the validity and strength of this relationship. It can be seen in these decision trees that hole length, fairway width, average driving distance and accuracy of the golfers impact their expected club selection off the tee.

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## 2. Method of Analysis

The goal of this analysis is to build a decision tree model for both short, medium and long hitters that can predict which club they will use off the teeing ground based on the length of the hole and width of the fairway. The model is trained using Shotlink data from the 2016 and 2017 PGA Tour season. The players are split up into three groups, short, medium and long hitters, based on their capabilities as golfers. The player capabilities are calculated by taking 90% of the average drive distance. This calculation allows us to look more closely at where in the fairway they are examining to decide which club to use. For short hitters (defined here as averaging less than 278 yards), the fairway width at 250 yards is included in the model and for medium hitters (defined here as averaging greater than 278 yards but less than 306), the fairway width at 275 yards is included in the model and for long hitters (averaging greater than 306 yards), the fairway width at 300 yards is included in the model. After the data is fully formed, an outlier analysis is preformed to cleanse the data of any extreme cases of drive distances.

The decision tree model will ultimately give us several different pathways a player may take to decide which club they will be using.

### 3. Decision Tree Modeling

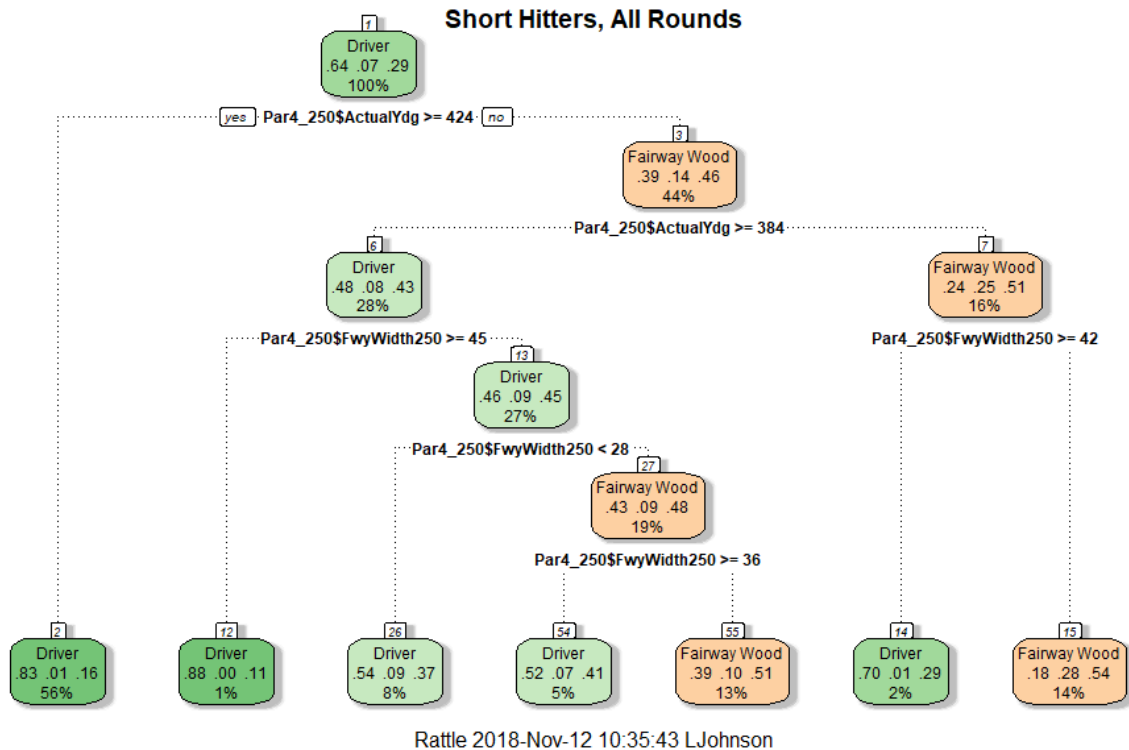


Figure 1 Short Hitters

The bottom row of boxes is referred to as the terminal nodes, or each box is a ‘leaf’. Within each leaf, below the word ‘Driver’ there are three numbers in decimal form. These numbers represent the proportion of golfers within that classification who choose each club. The proportion choosing driver is the furthest left number, Iron is the middle number and Fairway Wood is the furthest right number. Below those proportions is a percentage that represents that percentage of golfers that have reached that leaf after following each pathway. A description of the pathways a golfer may take is below.

Pathways explained from left to right:

1. Hole length greater than or equal to 424 yards: 83% choose driver
2. Hole length greater than or equal to 384 yards and less than 424 yards, fairway width greater than or equal to 45 yards: 88% choose driver
3. Hole length greater than or equal to 384 yards and less than 424 yards, fairway width less than 28 yards: 54% choose driver
4. Hole length greater than or equal to 384 yards and less than 424 yards, fairway width greater than or equal to 36 yards and less than 45 yards: 52% choose driver
5. Hole length greater than or equal to 384 and less than 424 yards, fairway width greater than or equal to 28 yards and less than 36 yards: 51% choose fairway wood
6. Hole length less than 384 yards and fairway width greater than or equal to 42 yards: 70% choose driver
7. Hole length less than 384 yards and fairway width less than 42 yards: 54% choose fairway wood

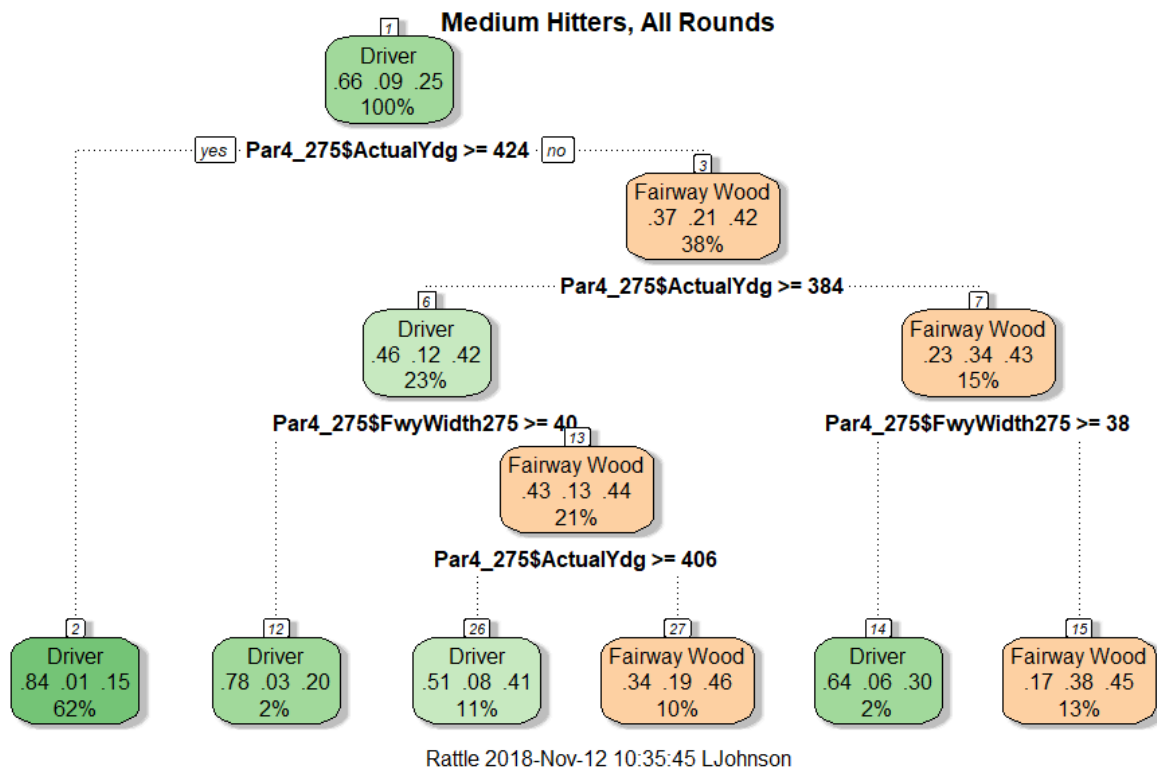


Figure 2 Medium Hitters

Pathways explained left to right:

1. Hole length greater than or equal to 424 yards: 84% choose driver
2. Hole length greater than or equal to 384 yards and less than 424 yards, fairway width greater than or equal to 40 yards: 78% choose driver
3. Hole length greater than or equal to 406 yards and less than 424 yards, fairway width less than 40 yards: 51% choose driver
4. Hole length greater than or equal to 384 yards and less than 406 yards, fairway width less than 40 yards: 46% choose fairway wood
5. Hole length less than 384 yards and fairway width greater than or equal to 38 yards: 64% choose driver
6. Hole length less than 384 yards and fairway width less than 38 yards: 45% choose fairway wood

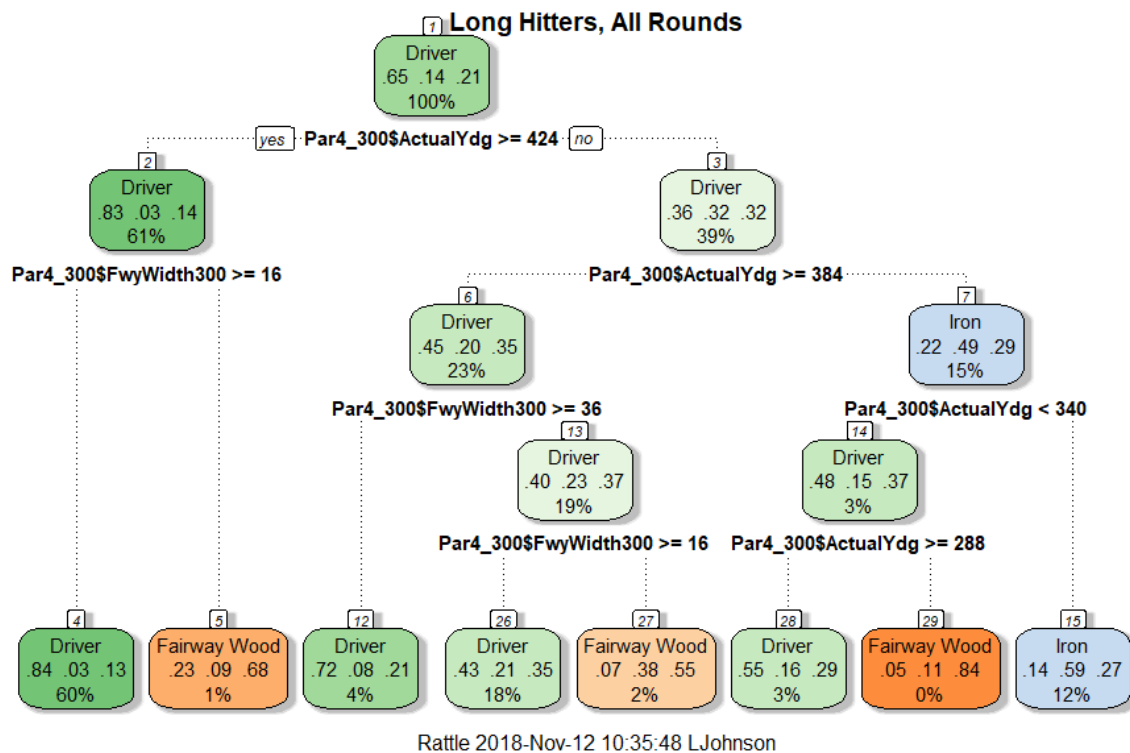


Figure 3 Long Hitters

Pathways explained left to right:

1. Hole length greater than or equal to 424 yards, fairway width greater than or equal to 16 yards: 84% choose driver
2. Hole length greater than or equal to 424 yards and fairway width less than 16 yards: 68% choose fairway wood
3. Hole length greater than or equal to 384 yards and less than 424 yards, fairway width greater than or equal to 36 yards: 72% choose driver
4. Hole length greater than or equal to 384 yards and less than 424 yards, fairway width greater than or equal to 16 yards and less than 36 yards: 43% choose driver
5. Hole length greater than or equal to 384 yards and less than 424 yards, fairway width less than 16 yards: 55% choose fairway wood
6. Hole length greater than or equal to 288 yards and less than 340 yards: 55% choose driver
7. Hole length less than or equal to 288 yards: 84% choose fairway wood
8. Hole length greater than or equal to 340 yards and less than 384 yards: 59% choose iron

### 3. Decision Tree Model with Player Capability and Accuracy

After examining the decision models for golfers of different capabilities, there is interest to incorporate the accuracy of the golfer into these models. Below are the decision models for short hitters, medium hitters and long hitters all with low and high accuracy statistics. Low accuracy is defined as a golfer having a fairway hit proportion greater than or equal to 0.50 and less than 0.62. High accuracy is defined as a golfer having a fairway hit proportion greater than or equal to 0.62 and less than or equal to 0.75. The median fairway hit proportion of the data sample is 0.62.

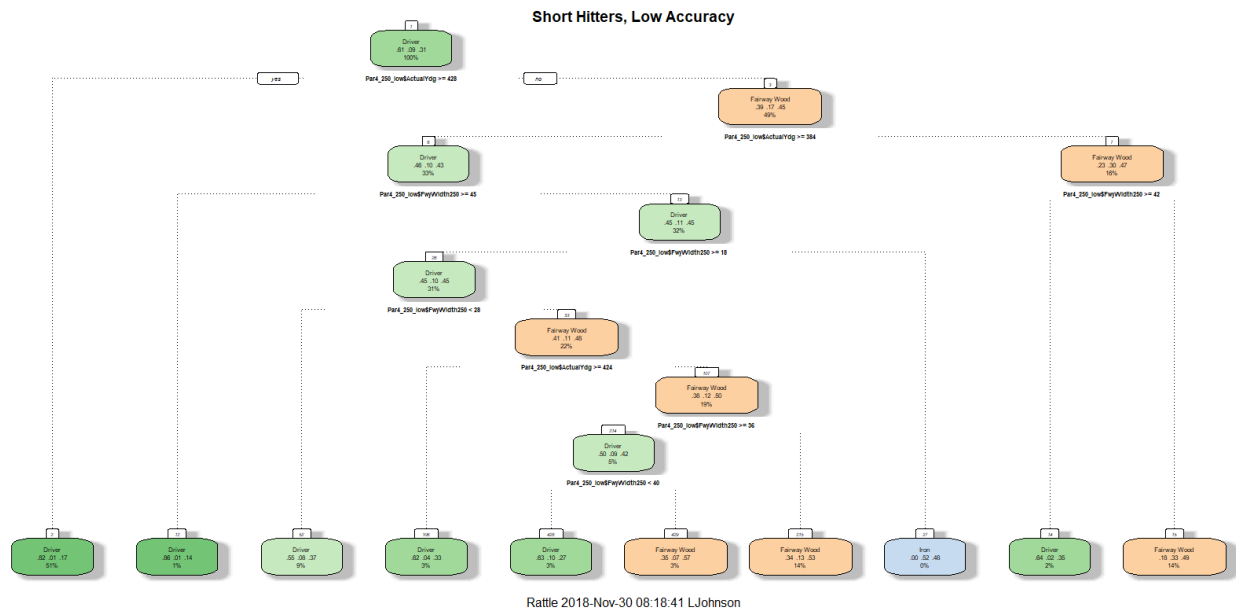


Figure 4 Short Hitters with Low Accuracy

Pathways explained left to right:

1. Hole length greater than or equal to 428 yards: 82% choose driver
2. Hole length greater than or equal to 384 yards and less than 428 yards, fairway width greater than or equal to 45 yards: 86% choose driver
3. Hole length greater than or equal to 384 yards and less than 428 yards, fairway width greater than or equal to 18 yards and less than 28 yards: 55% choose driver
4. Hole length greater than or equal to 424 yards and less than 428 yards, fairway width greater than or equal to 28 yards and less than 45 yards: 62% choose driver
5. Hole length greater than or equal to 424 yards and less than 428 yards, fairway width greater than or equal to 36 yards and less than 40 yards: 63% choose driver
6. Hole length greater than or equal to 424 yards and less than 428 yards, fairway width greater than or equal to 40 yards and less than 45 yards: 57% choose fairway wood
7. Hole length greater than or equal to 424 yards and less than 428 yards, fairway width greater than or equal to 28 yards and less than 36 yards: 53% choose fairway wood
8. Hole length greater than or equal to 384 yards and less than 428 yards, fairway width greater than or equal to 18 yards: 52% choose iron
9. Hole less than 384 yards, fairway width greater than or equal to 42 yards: 64% choose driver
10. Hole length less than 384 yards, fairway width less than 42 yards: 49% choose fairway wood

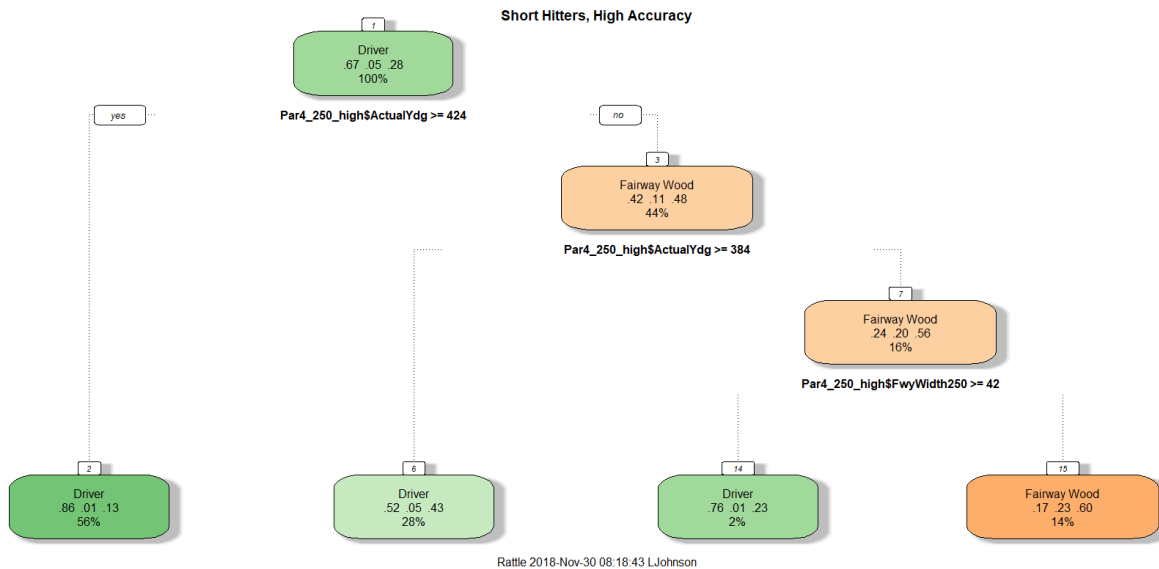


Figure 5 Short Hitters with High Accuracy

Pathways explained left to right:

1. Hole length greater than or equal to 424 yards: 86% choose driver
2. Hole length greater than or equal to 384 yards and less than 424 yards: 52% choose driver
3. Hole length less than 384 yards and fairway width greater than or equal to 42 yards: 76% choose driver
4. Hole length less than 384 yards and fairway width less than 42 yards: 60% choose fairway wood

Summary of shorter hitters:

It is apparent that shorter hitters with a lower accuracy statistic have a more complex decision-making model than ones with higher accuracy statistic. There may be a lack of confidence in any one club off the tee due to the lower accuracy statistic than the more accurate group of golfers. One will notice the small impact fairway width has on any one decision made in the model describing the more accurate golfers. The one pathway that includes fairway width leads to a decision to use a fairway wood.

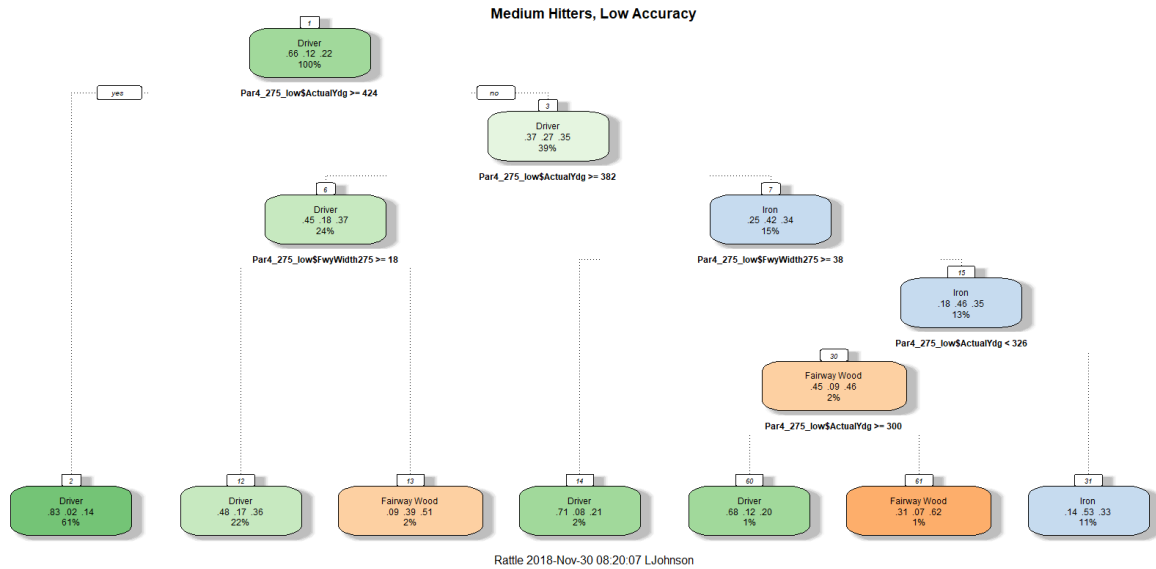


Figure 6 Medium Hitters with Low Accuracy

Pathways explained left to right:

1. Hole length greater than or equal to 424 yards: 83% choose driver
2. Hole length greater than or equal to 382 yards and less than 424 yards, fairway width greater than or equal to 18 yards: 48% choose driver
3. Hole length greater than or equal to 382 yards and less than 424 yards, fairway width less than 18 yards: 51% choose fairway wood
4. Hole length less than 382 yards and fairway width greater than or equal to 38 yards: 71% choose driver
5. Hole length greater than or equal to 300 yards and less than 326 yards, fairway width less than 38 yards: 68% choose driver
6. Hole length less than 300 yards and fairway width less than 38 yards: 62% choose fairway wood
7. Hole length greater than or equal to 326 yards and less than 382 yards, fairway width less than 38 yards: 53% choose iron

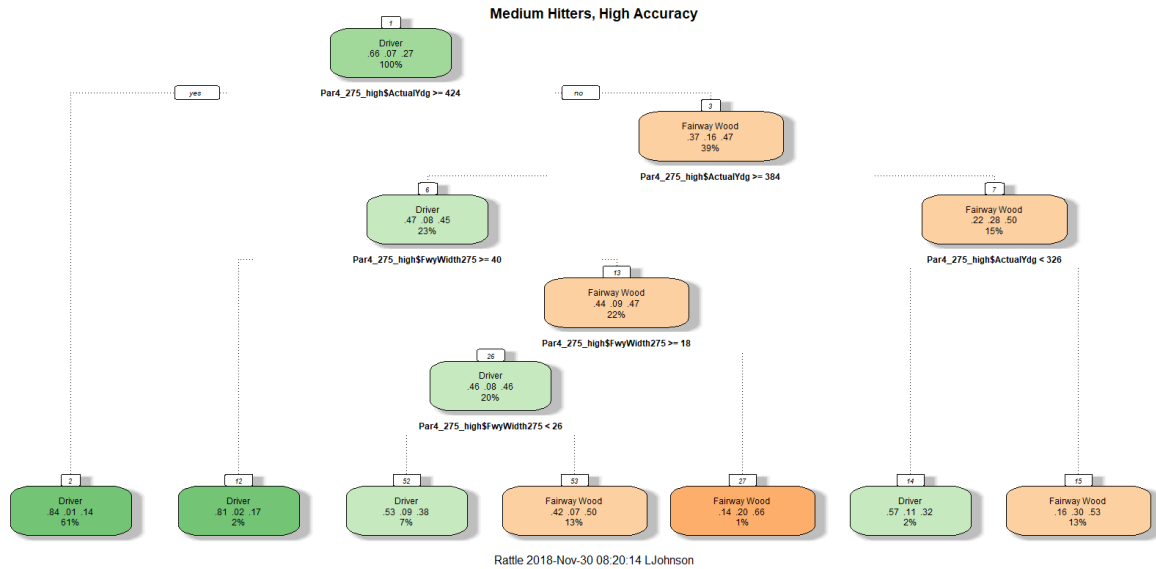


Figure 7 Medium Hitters with High Accuracy

Pathways explained left to right:

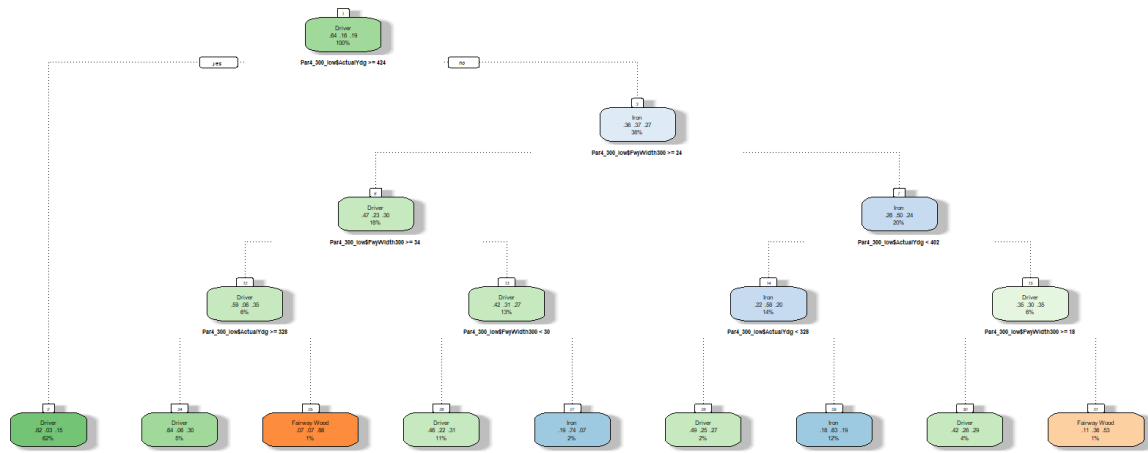
1. Hole length greater than or equal to 424 yards: 84% choose driver
2. Hole length greater than or equal to 384 yards and less than 424 yards, fairway width greater than or equal to 40 yards: 81% choose driver
3. Hole length greater than or equal to 384 yards and less than 424 yards, fairway width greater than or equal to 18 yards and less than 26 yards: 53% choose driver
4. Hole length greater than or equal to 384 yards and less than 424 yards, fairway width greater than or equal to 26 yards and less than 40 yards: 50% choose fairway wood
5. Hole length greater than or equal to 384 yards and less than 424 yards, fairway width less than 18 yards: 66% choose fairway wood
6. Hole length less than 326 yards: 57% choose driver
7. Hole length greater than or equal to 326 yards and less than 384 yards: 53% choose fairway wood

Summary of medium hitters:

Again, there is more diversity among which club is utilized off the tee for less accurate golfers than more accurate golfers. An iron is often chosen when the width of the fairway comes into question due to the lack of confidence in accuracy when using a longer club.



### Long Hitters, Low Accuracy



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Figure 8 Long Hitters with Low Accuracy

Pathways explained left to right:

1. Hole length greater than or equal to 424 yards: 82% choose driver
2. Hole length greater than or equal to 328 yards and less than 424 yards, fairway width greater than or equal to 34 yards: 64% choose driver
3. Hole length less than 328 yards and fairway width greater than or equal to 34 yards: 86% choose fairway wood
4. Hole length less than 424 yards, fairway width greater than or equal to 24 yards and less than 30 yards: 46% choose driver
5. Hole length less than 424 yards, fairway width greater than or equal to 30 yards and less than 34 yards: 74% choose iron
6. Hole length less than 328 yards and fairway width less than 24 yards: 49% choose driver
7. Hole length greater than or equal to 328 yards and less than 402 yards, fairway width less than 24 yards: 63% choose iron
8. Hole length greater than or equal to 402 yards and less than 424 yards, fairway width greater than or equal to 18 yards and less than 24 yards: 42% choose driver
9. Hole length greater than or equal to 402 yards and less than 424 yards, fairway width less than 18 yards: 53% choose fairway wood

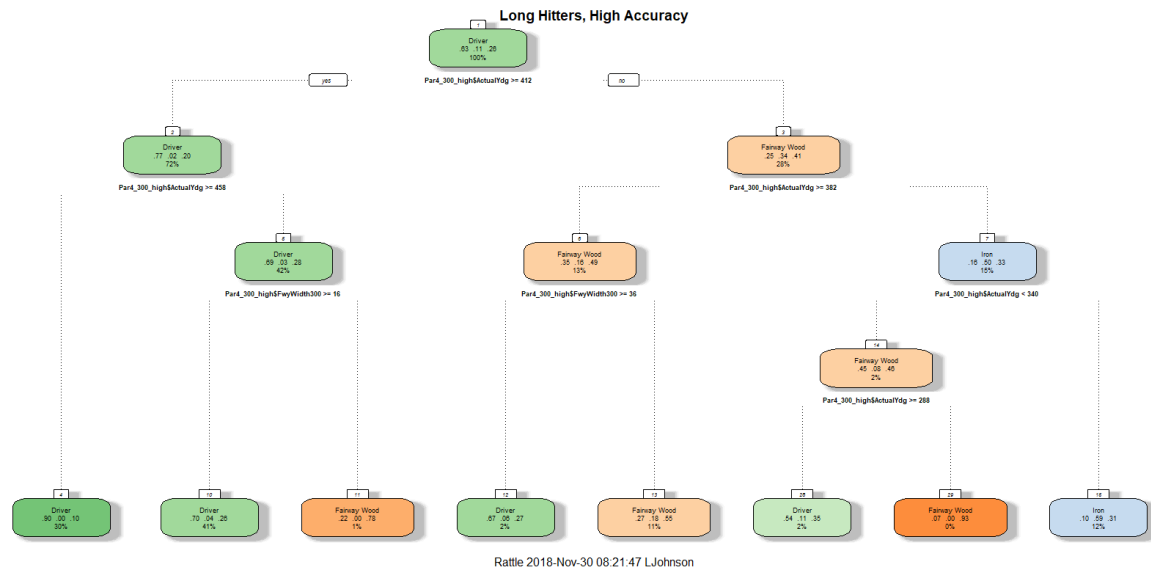


Figure 9 Long Hitters with High Accuracy

Pathways explained left to right:

1. Hole length greater than or equal to 458 yards: 90% choose driver
2. Hole length greater than or equal to 458 yards and fairway width greater than or equal to 16 yards: 69% choose driver
3. Hole length greater than or equal to 458 yards and fairway width less than 16 yards: 78% choose fairway wood
4. Hole length greater than or equal to 382 yards and less than 412 yards, fairway width greater than or equal to 36 yards: 67% choose driver
5. Hole length greater than or equal to 382 yards and less than 412 yards, fairway width less than 36 yards: 55% choose fairway wood
6. Hole length greater than or equal to 288 yards and less than 340 yards: 54% choose driver
7. Hole length less than 288 yards: 93% choose fairway wood
8. Hole length greater than or equal to 340 yards and less than 382 yards: 59% choose iron

Summary of longer hitters:

The theme of increased diversity for less accurate golfers is present for the group of long hitters. There are many more decisions that end up in choosing an iron off the tee when the golfer is less accurate. Even though they can hit the ball far, they may not have high odds of landing in the fairway and that is influencing their club decision.

## 4. Conclusion

Across all player capabilities, the less accurate a golfer is, the more complex the decision-making model is. The less accurate the golfer, the more likely they are to choose a club that is shorter off the tee in order to increase their chance of landing in the fairway. When introducing accuracy into the model, it is evident that fairway width has a larger influence on the type of club a golfer is choosing rather than just the length of the hole.

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