NFL Onside Kick Analysis

Introduction

The goal of this project is to provide an analysis of onside kicks in the NFL.

In American football, a team kicks off the ball from the 35 yard line to the opposing team, giving them possession. However, the kicking team has the option to perform an onside kick. The onside kick may be recovered by the kicking team so that they retain possession. Performing an onside kick is often seen as an act of desperation since there is a high chance of failure, but recovering the onside kick leads to advantageous field position.

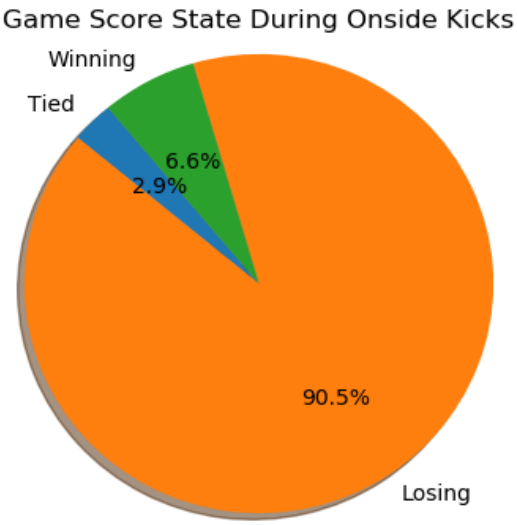
My project is important because if a team were able to recover more onside kicks, their drives would start from at least the 45 yard line and more importantly keep the ball away from the opposing team.

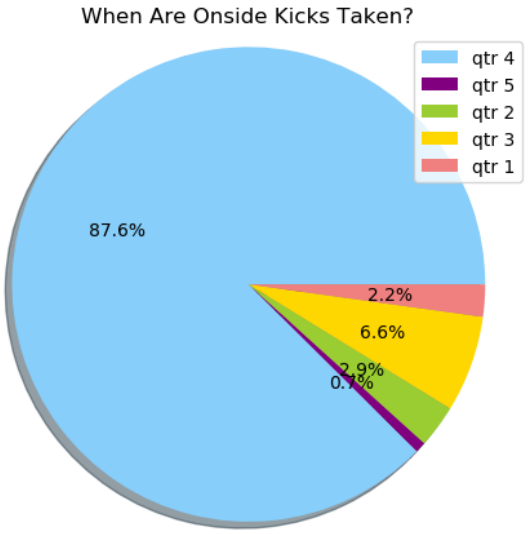
Background Information

Data

I collected NFL play by play data using `nflscrapR` for the 2011-2012 through 2015-2016 seasons. The reason I chose those seasons is because of the frequent rules changes regarding kickoffs in the NFL. The kickoff line was moved up 5 yards in 2011 and the touchback line was moved out 5 yards as well in 2016.

The graph below shows the kicking team's score margin when they attempt onside kicks. 90.5% of the time the kicking team is losing. Clearly, teams almost always attempt onside kicks when they are losing late in the game.



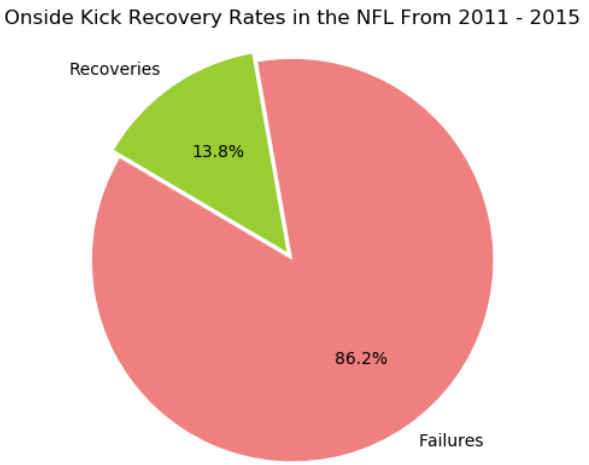


Onside kicks are viewed as a last ditch act of desperation. The graph above shows when teams attempt onside kicks in games. Teams predominantly attempt onside kicks in the 4th quarter.

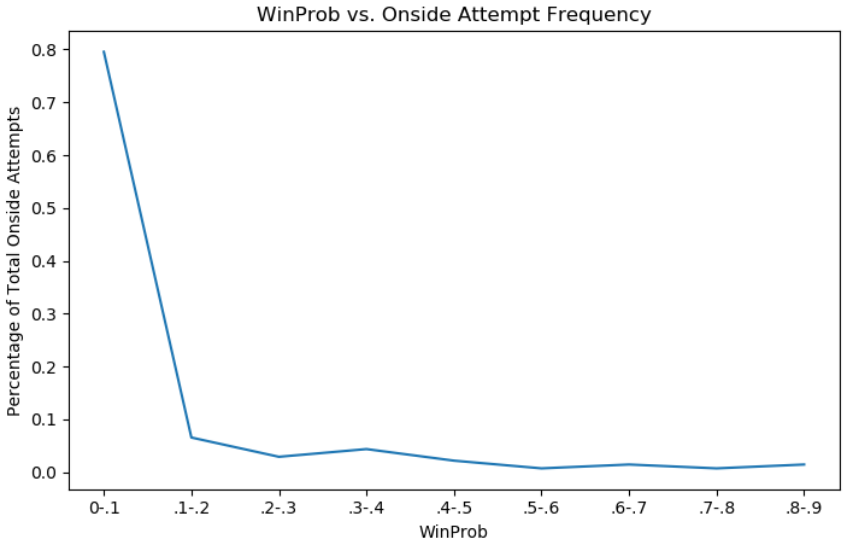
Note: qtr 5 means overtime.

Analysis

Onside kicks are not easy to recover. Between the 2011 and 2015 seasons, only 13.8% of all onside kicks have been recovered by the kicking team.



A 13.8% recovery rate may seem low, but we will more closely examine the context in which teams attempt onside kicks to understand why they attempt something so likely to fail.

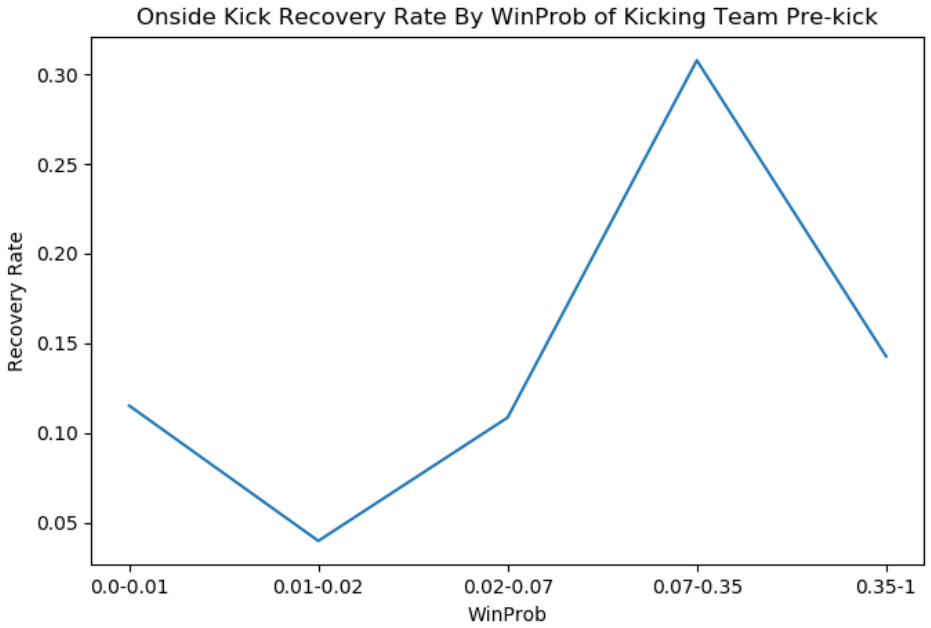


The above graph shows onside kick frequencies as a function of of the kicking team's win probability before attempting the kick.

We can see by looking at the graph that when teams have between a 0% and 10% chance of winning they are far more likely to perform an onside kick. Nearly 80% of all onside kicks between 2011 and 2015 were attempted when the kicking team had less than a 10% chance of winning. These findings support the intuition that onside kicks are reserved for desperate situations.

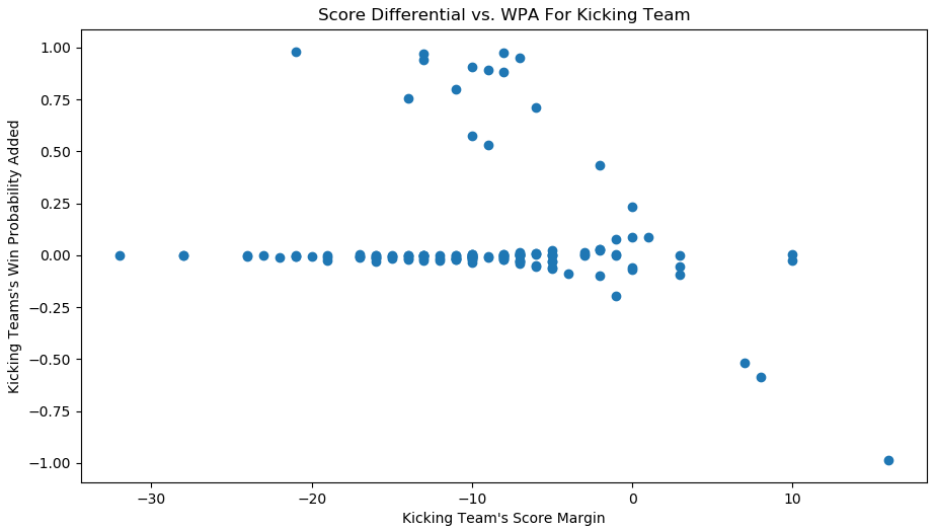
So far our results have been rather unsurprising. Not all onside kicks are create equal, so let us examine under what circumstances onside kicks are more likely to succeed.

I binned the kicking team's win probability and calculated the recovery rate for each bin. Due to small sample size, the recovery rates are sensitive.



The above graph shows onside kick recovery rates as a function of the kicking team's win probability. We observe a sharp rise in recovery rate when the kicking team has a greater than 7% chance of winning. When the onside kick is *unexpected*, the kicking team has a better chance of recovery.

We can further examine the payoff of onside kicks by looking at the relationship between the kicking team's current score margin and the win probability added after attempting an onside kick. When the kicking team is tied or losing, a successful onside can improve their chances of winning by as much as 90%, while failing to recover the onside kick doesn't change their win probability by that much. This effect is likely explained by the fact that teams predominantly attempt onside kicks when they have less than a 10% chance of winning (as we discovered earlier), so failing the onside kick recovery has a negligible effect.



Comparison to Kickoffs

So far we have analyzed onside kicks in a vacuum. Let us now compare onside kicks to normal kickoffs. After all, a team has to kickoff the ball somehow.

	WPA for Kicking Team	EPA for Kicking Team
Normal Kickoff	-0.0033658408363433463	-0.12039524531629114
Onside Attempt	-0.08863775940501385	-0.5468192112658555
Successful Onside	0.536924811234172	1.3050474415043156
Failed Onside	-0.016455945974895168	-0.8450011299322384

At first glance, an onside attempt results in a lower WPA than a normal kickoff does for the kicking team. Further, an onside attempt also results in a lower EPA (expected points added). The question now becomes, what recovery rate makes an onside kick worth the risk?

$$let\ x\ be\ the\ breakeven\ recovery\ rate\ for\ onside\ kicks$$

$$EPA(successful\ onside)x + (1-x)\big(EPA(failed\ onside)\big) = EPA(normal\ kickoff)$$

$$1.3x + (1-x)(-.85) = -.12$$

$$1.3x - .85 + .85x = -.12$$

$$2.15x = .73$$

$$x = .34$$

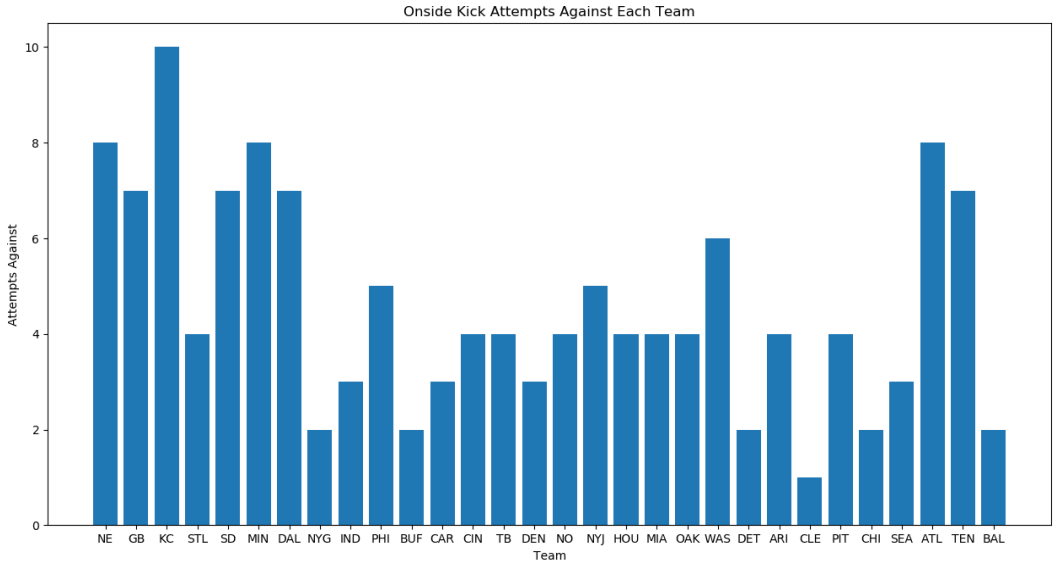
We can expect that at 34% recovery rate for onside kicks they have a better payoff than a normal kick off.

However, according to our earlier findings, teams collectively have a 13.8% recovery rate. We also discovered that onside kicks are more likely to succeed when least expected. Even then, when the kicking team has greater than 7% of winning and the recovery rate is roughly 30%, the breakeven rate of 34% is still too high.

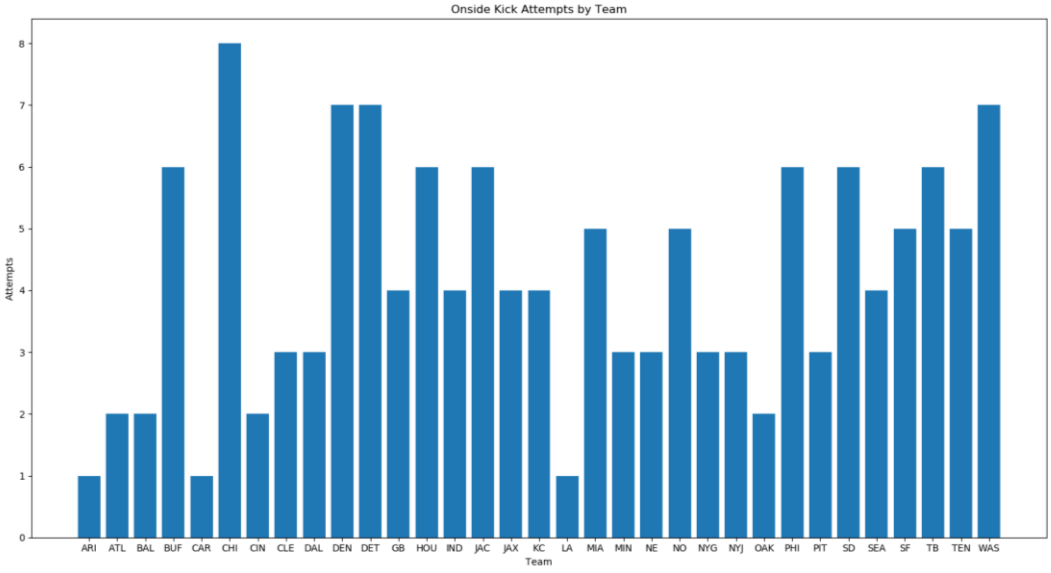
Conclusion

In this project we examined the circumstances under which teams attempt onside kicks, as well as what factors affect onside recovery rates. We concluded that the breakeven recovery rate of 34% is higher than the most optimistic recovery rates for onside kicks. Therefore, traditional kickoffs are still preferred.

Other Interesting Information



The above bar chart shows how many onside kicks were attempted against each team. I thought that this was interesting because "good" teams had more kicks attempted against them than "bad" teams. For example, there was only 1 onside kick attempt against the Browns but 8 against the Patriots.



This bar chart shows the reverse of the previous one. This graph shows how many times each team has attemped an onside kick.

NBA Predictor

Check out my side project, a real time in game NBA win probability app https://github.com/lukegerhart/Predictor