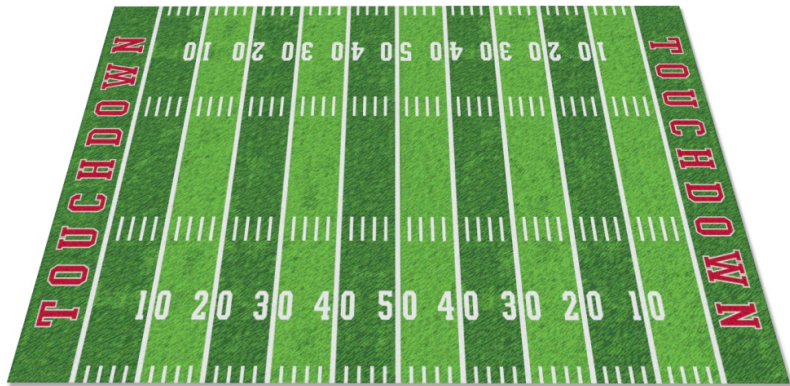


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The Game



In this project our goal is to help NFL coaches better determine when to attempt to go for a first down on a fourth down play.

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In football there are many decisions a team needs to make in order to win the game. In this project we focus on the decision that needs to be made on the 4th down of any given play. There are three decisions to be made on the fourth down.

1. Punt
2. Kick a field goal
3. Go for a first down

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We attempt to determine which decision should be made under certain conditions. The following are the conditions which we take into account in determining the decision.

1. Offensive and defensive rank of the offensive team
2. Offensive and defensive rank of the defensive team
3. The number of yards to convert a first down
4. The field position

With this information from the data we were able to estimate the expected points scored for each of the three decisions. Finally, with this information a decision can be made.

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The Data

The data that we have chosen to attempt to answer this research question is NFL play-by-play data for seasons 2002 - 2012. The play-by-play data includes a game ID, which quarter, which down, which teams, a play description, and the number of points scored. A lot of data cleaning and manipulation was required to successfully analyze the data and even more work may be required to get more accurate predictions. From the data we ranked the teams according to their defense and offense to minimize any team specific effects that is inherent in the data.

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Determining the Decision

Let $Points_o$ and $Points_d$ be the number of points the offensive and defensive team will score respectively. Let $Punt$, $FieldGoal$, and $GoForIt$ be the events that the offensive team punts, attempts a field goal and goes for the 1st down given they are on their fourth down respectively. Let S_f and S_g be the events that the offensive team successfully scores a field goal and successfully converts a first down respectively. Then let

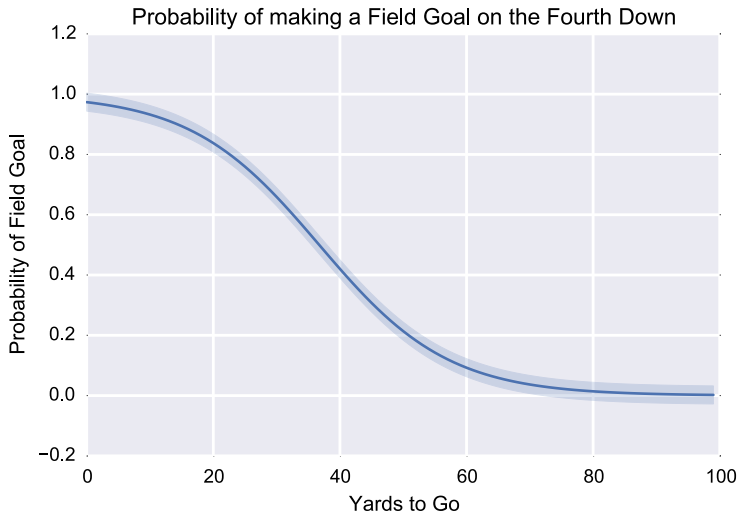
$$P = E[Points_o | Punt]$$

$$G = E[Points_o | GoForIt] = E[Points_o | S_g]P(S_g) - E[Points_d | S_g^c]P(S_g^c)$$

$$F = E[Points_o | FieldGoal] = E[Points_o | S_f]P(S_f) - E[Points_d | S_f^c]P(S_f^c)$$

Then Decision = $argmax\{P, G, F\}$.

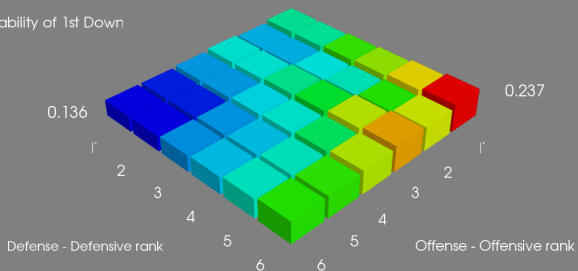
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Probability of Converting a First Down on the Fourth Down with more than 21 Yards to Go

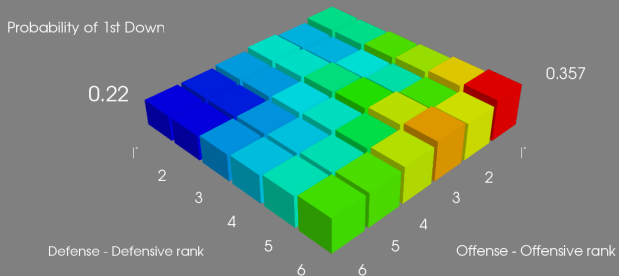
Probability of 1st Down



*Note: 32 offensive and defensive ranks are binned into six groups, with 1 the best.

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Probability of Converting a First Down on the Fourth Down with 14-17 Yards to Go

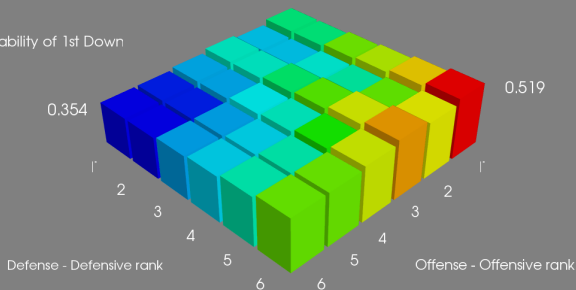


*Note: 32 offensive and defensive ranks are binned into six groups, with 1 the best.

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Probability of Converting a First Down on the Fourth Down with 6-7 Yards to Go

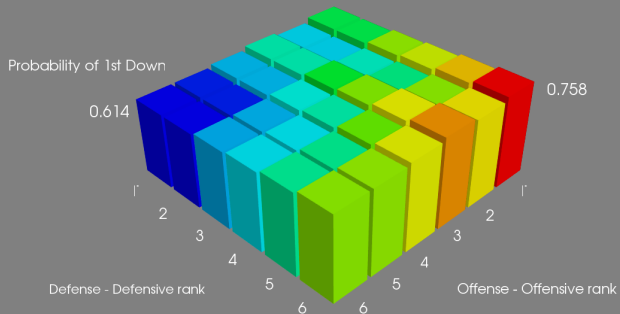
Probability of 1st Down



*Note: 32 offensive and defensive ranks are binned into six groups, with 1 the best.

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Probability of Converting a First Down on the Fourth Down with 1-2 Yards to Go

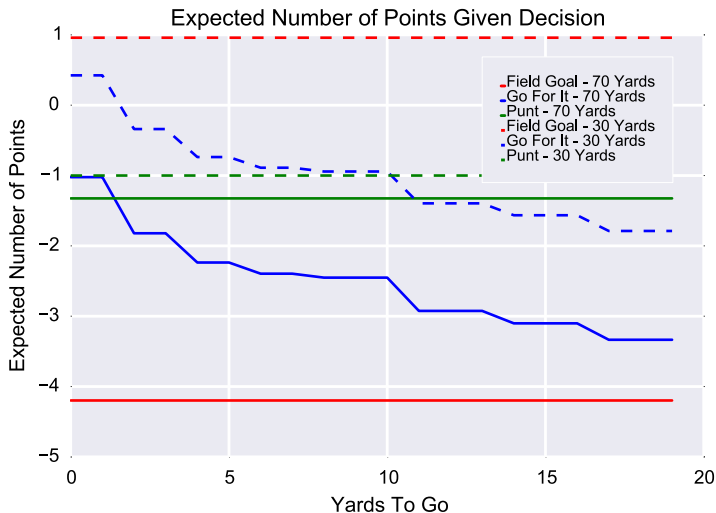


*Note: 32 offensive and defensive ranks are binned into six groups, with 1 the best.

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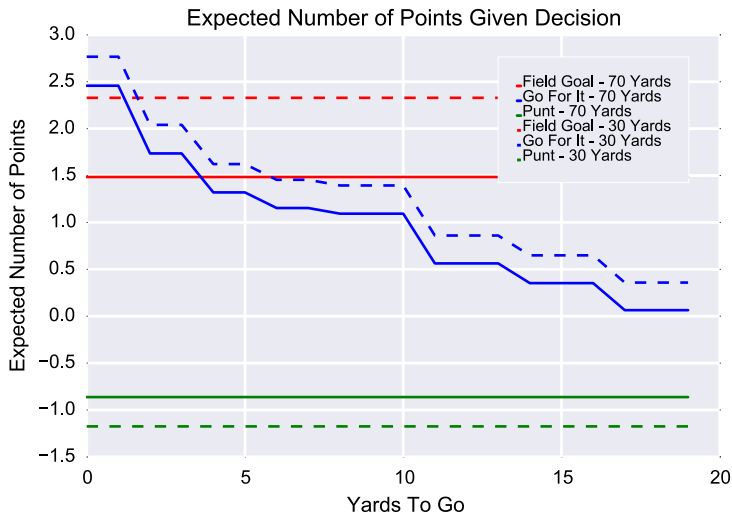
Offense Ranking: Offensive 26, Defensive 30

Defense Ranking: Offensive 5, Defensive 1



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Offense Ranking: Offensive 1, Defensive 2
Defense Ranking: Offensive 25, Defensive 20



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What should my decision be?

Offense Ranking: Offensive 1, Defensive 1
Defense Ranking: Offensive 10, Defensive 10

