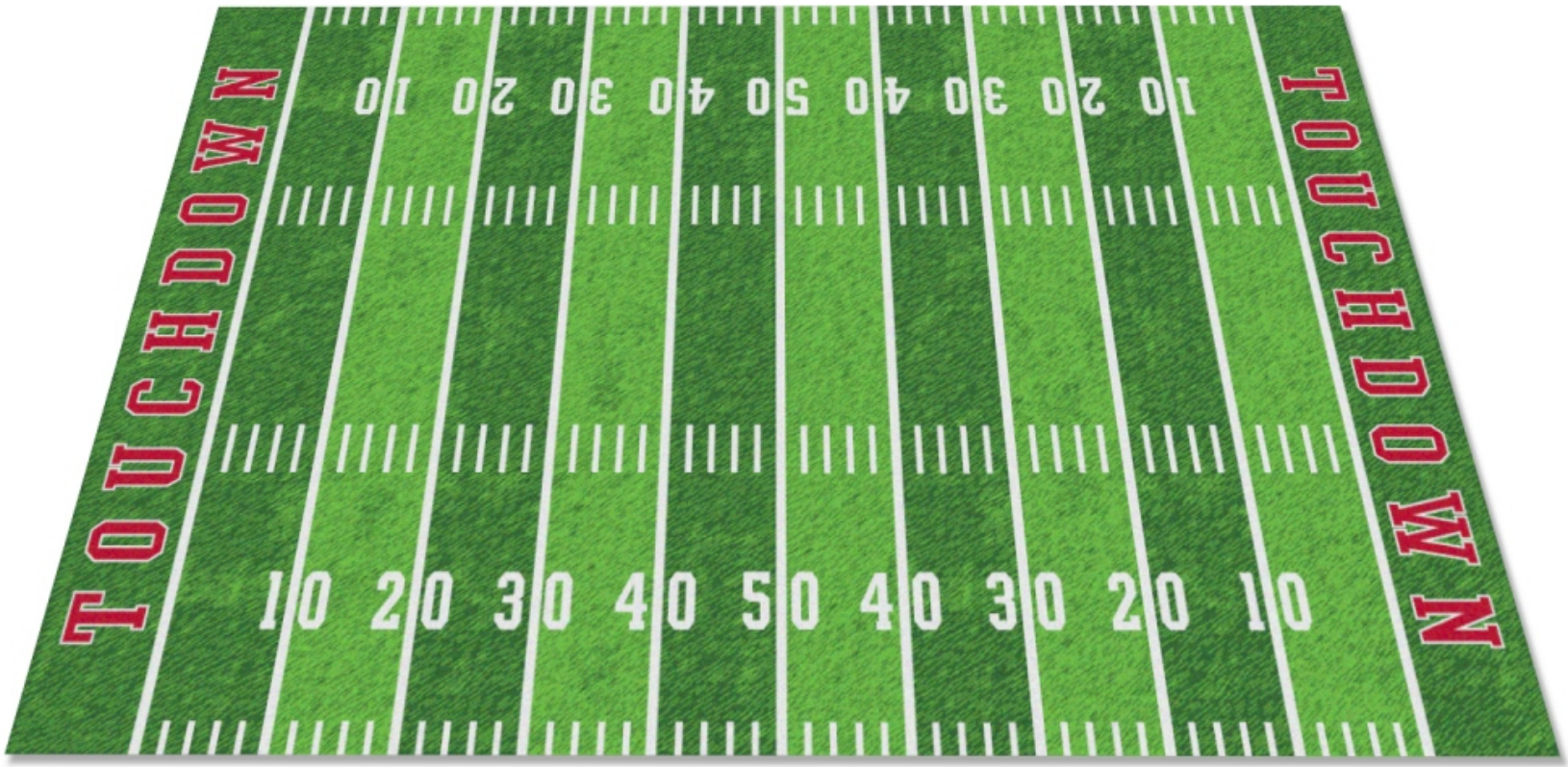
NFL Go For It!

The 4th Down Decision



by Mike Ghirardo and Thomas McCann

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In American Football there are many decisions a team needs to make in order to win the game. In this project we focus on those that need to be made on 4th down plays. Following are the 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 choice should be made under certain conditions. The following are the conditions which we take into account in determining the best action.

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 given 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.

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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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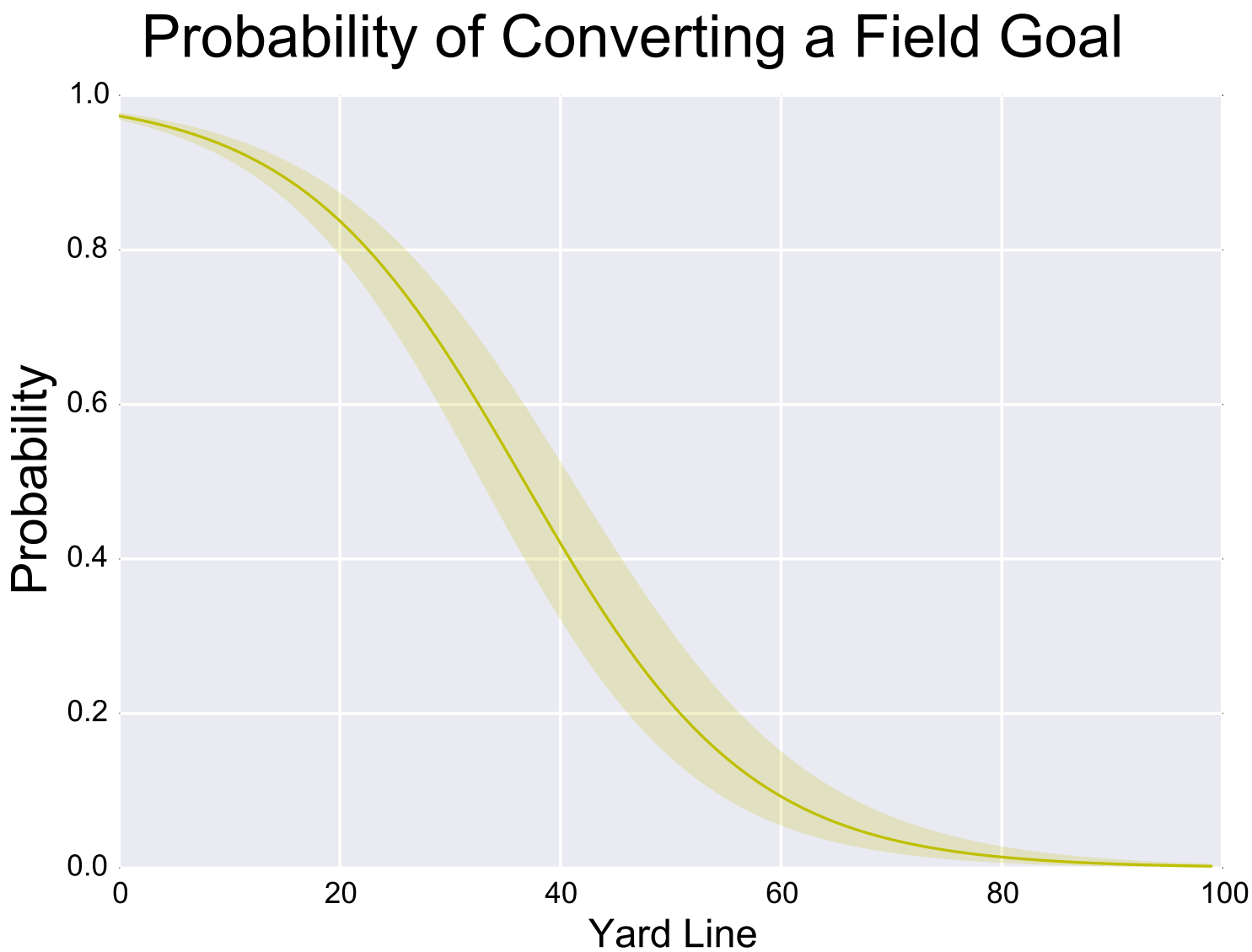
Probability of Converting a Field Goal
Probability
1.0
0.8
0.6
0.4
0.2
0.0
0
20
40
60
80
100
Yard Line

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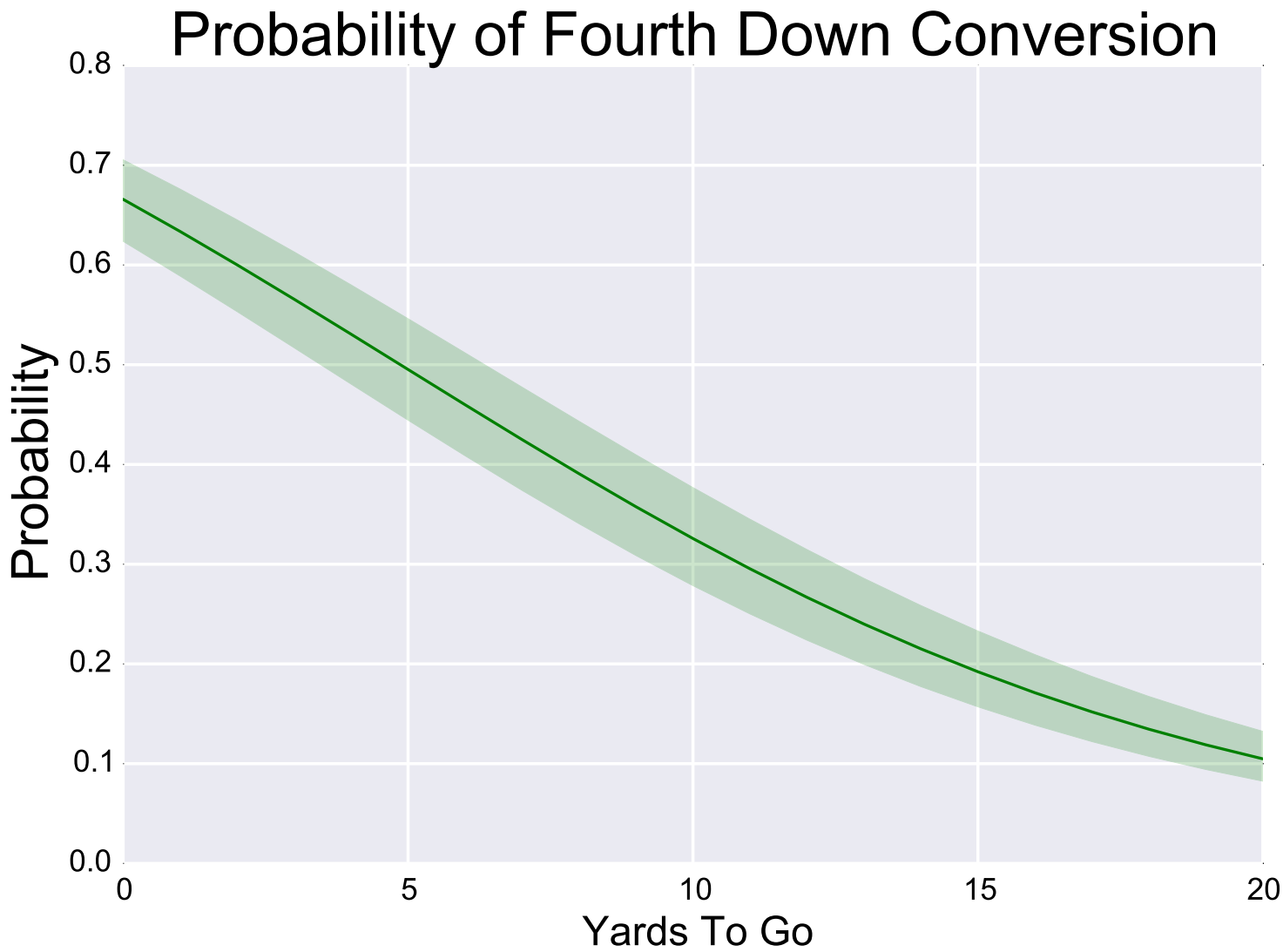
Probability of Fourth Down Conversion
Probability
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0
5
10
15
20
Yards To Go

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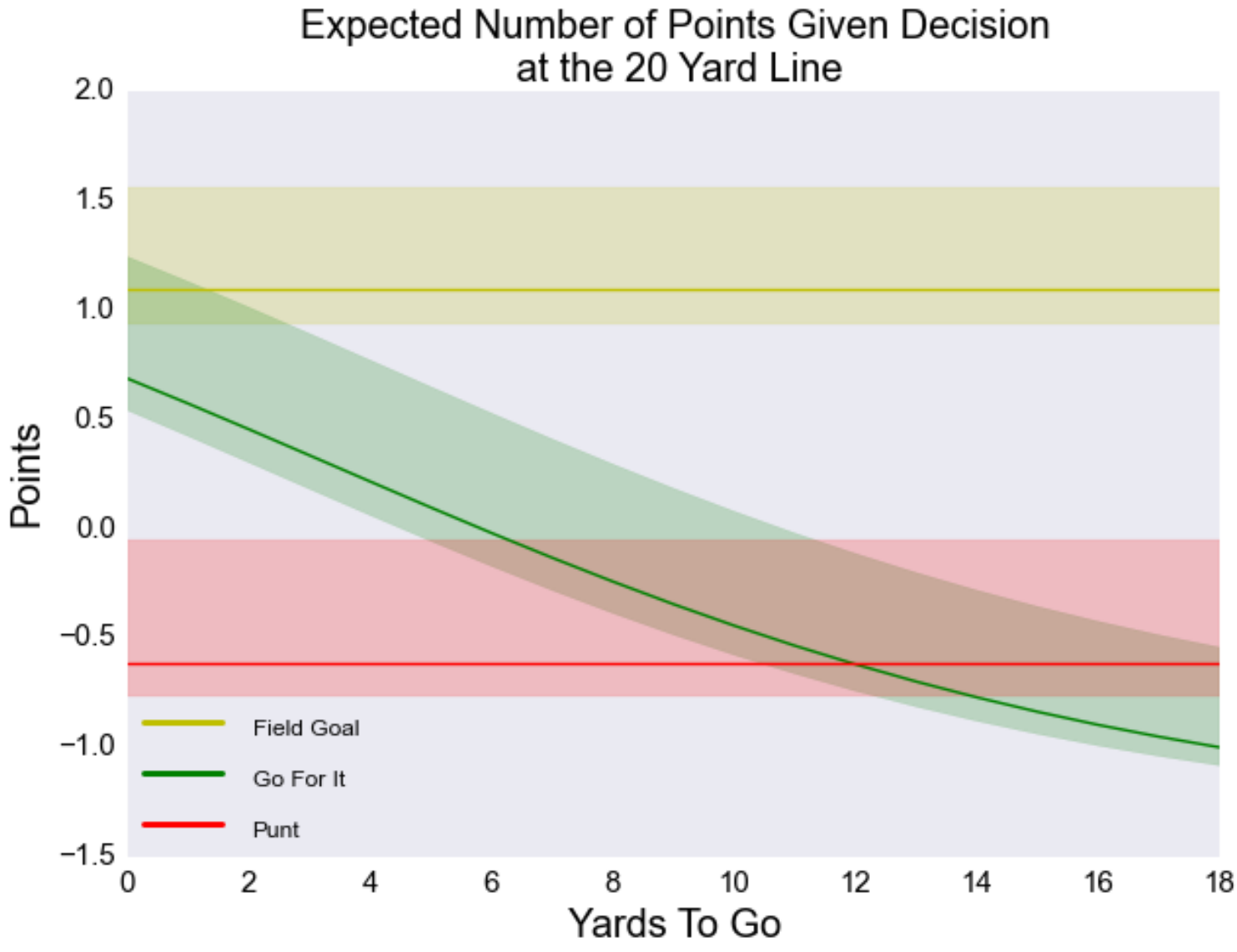
Expected Number of Points Given Decision
at the 20 Yard Line
Points
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
Field Goal
Go For It
Punt
0
2
4
6
8
10
12
14
16
18
Yards To Go

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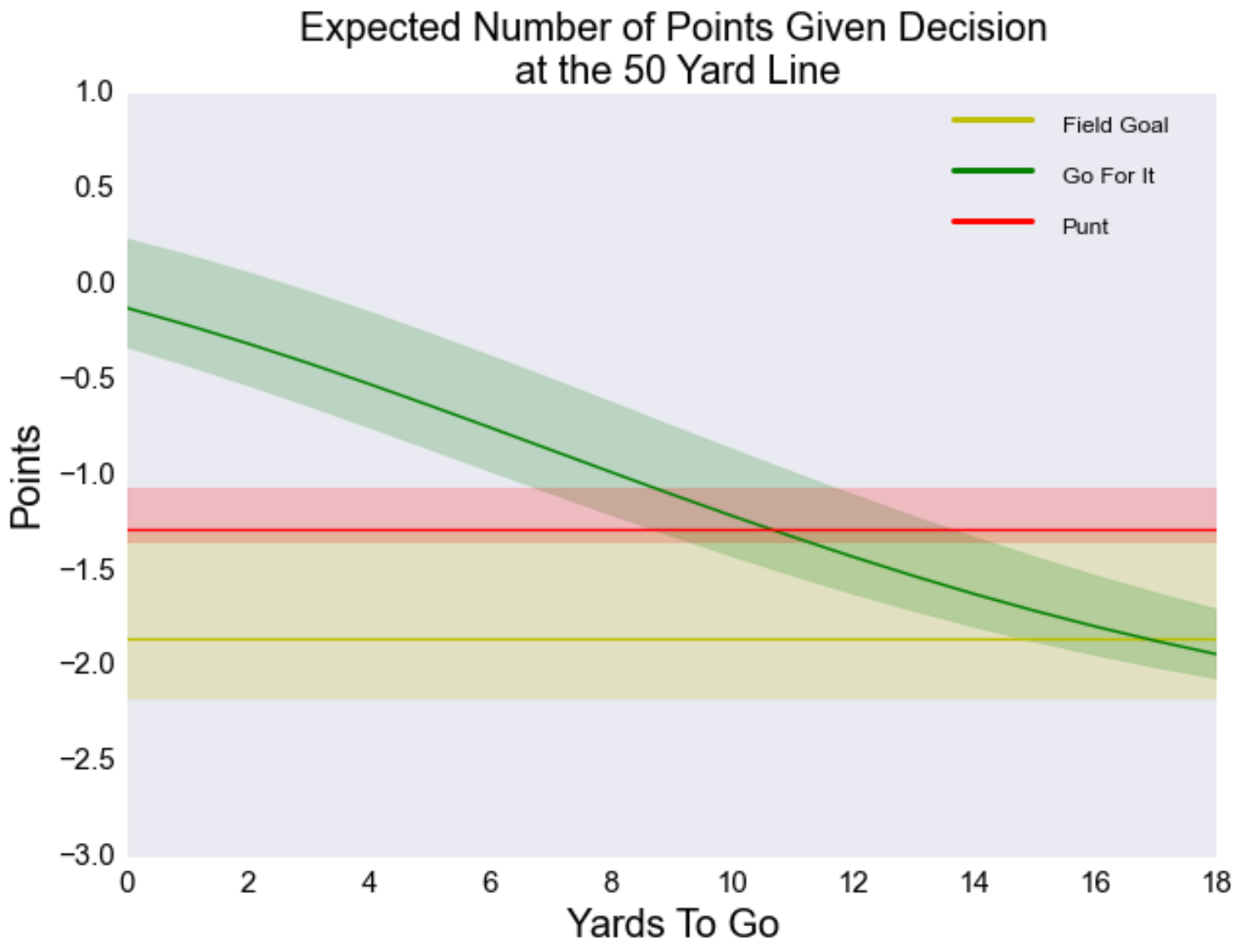
Expected Number of Points Given Decision
at the 50 Yard Line
Field Goal
Go For It
Punt
Points
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
0
2
4
6
8
10
12
14
16
18
Yards To Go

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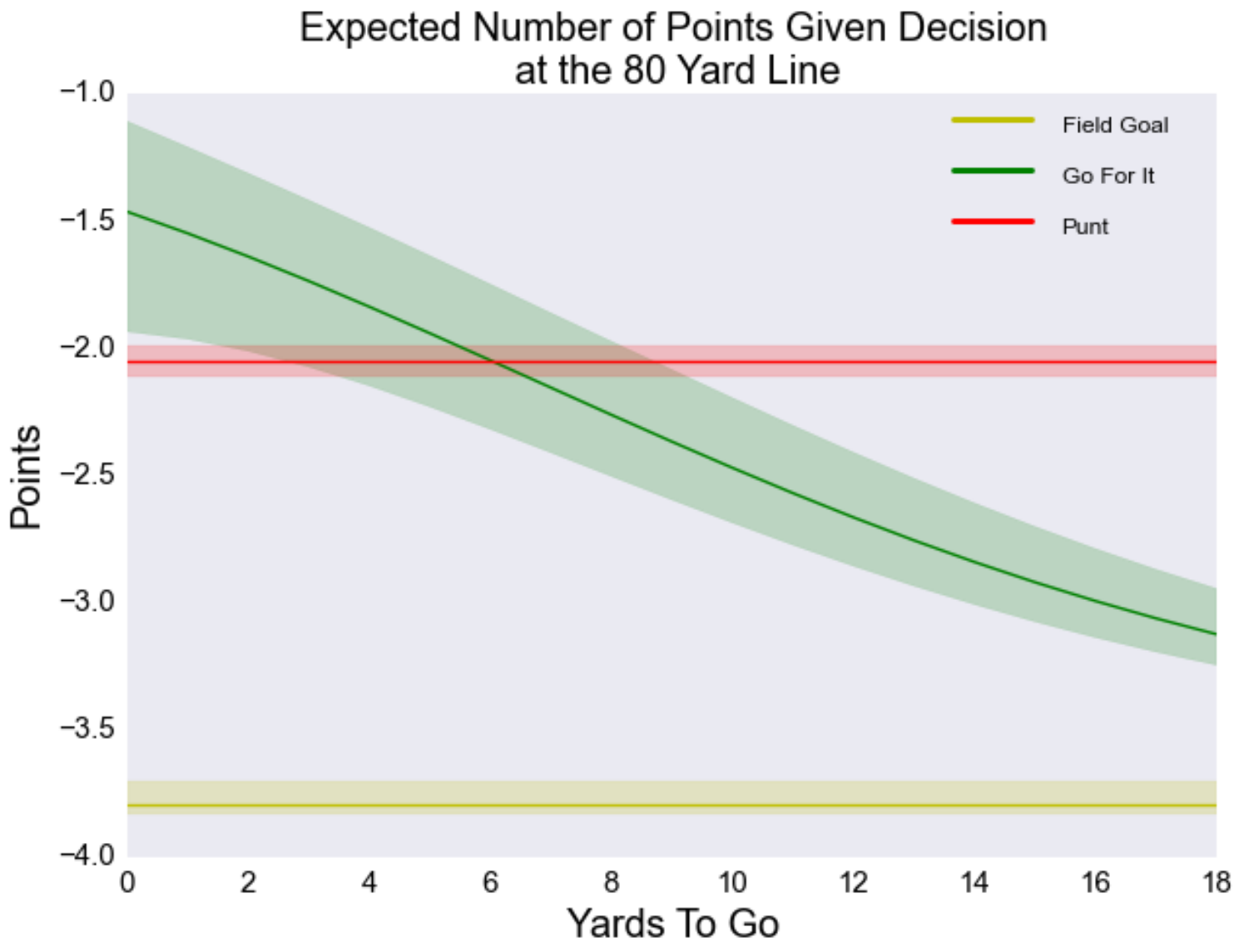
Expected Number of Points Given Decision
at the 80 Yard Line
Field Goal
Go For It
Punt
Points
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0
0
2
4
6
8
10
12
14
16
18
Yards To Go

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Determining the Decision

50 Yard Line, 5 Yards to Go
Offense Rank: Medium; Defense Rank: Medium

$$P = E[Points_o|Punt] = -1.28$$

$$G = E[Points_o|GoForIt] = E[Points_o|S_g]P(S_g) - E[Points_d|S_g^c]P(S_g^c)$$
$$= 1.29(.50) + (-2.52)(1 - .50) = -.63$$

$$F = E[Points_o|FieldGoal] = E[Points_o|S_f]P(S_f) - E[Points_d|S_f^c]P(S_f^c)$$
$$= 1.63(.21) + (-2.80)(1 - .21) = -1.86$$

$$\text{Decision} = argmax\{P, G, F\}$$

$$= argmax\{-1.28, -0.63, -1.86\} = \text{Go For It!}.$$

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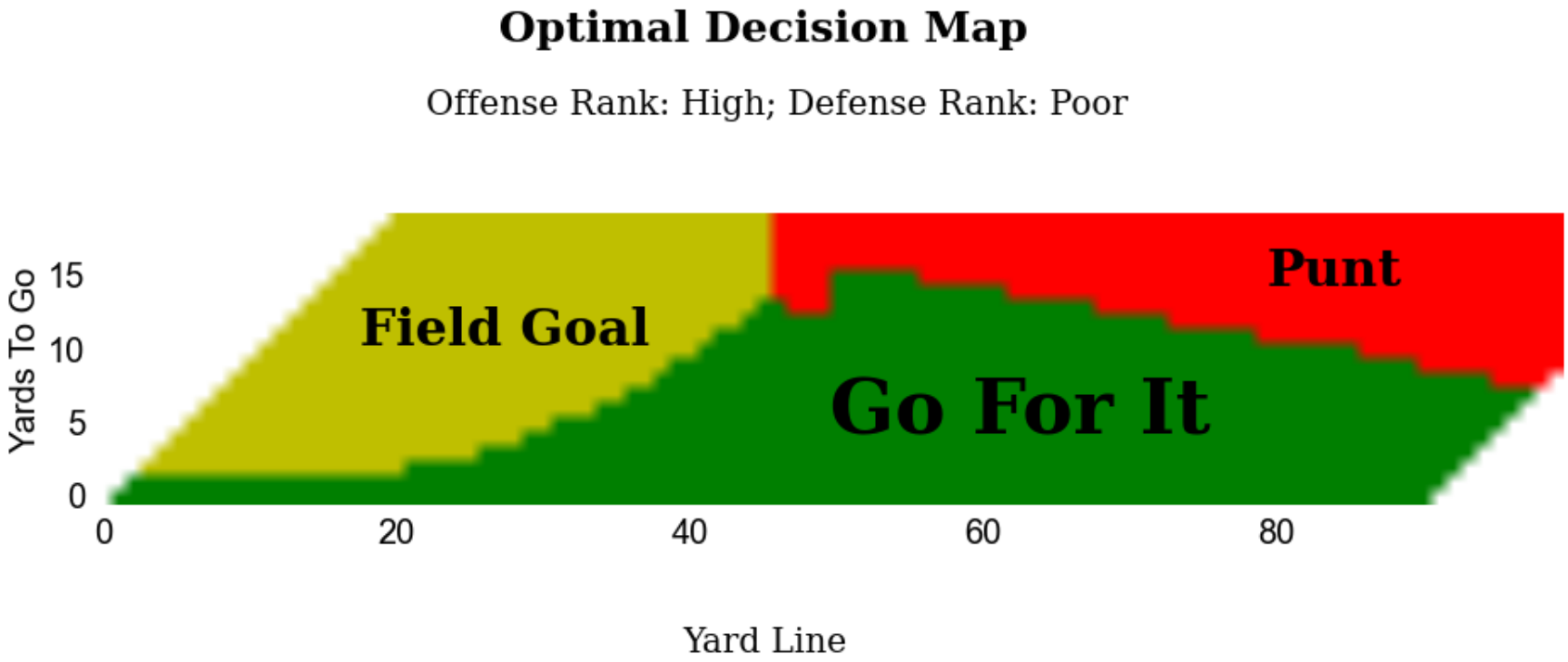
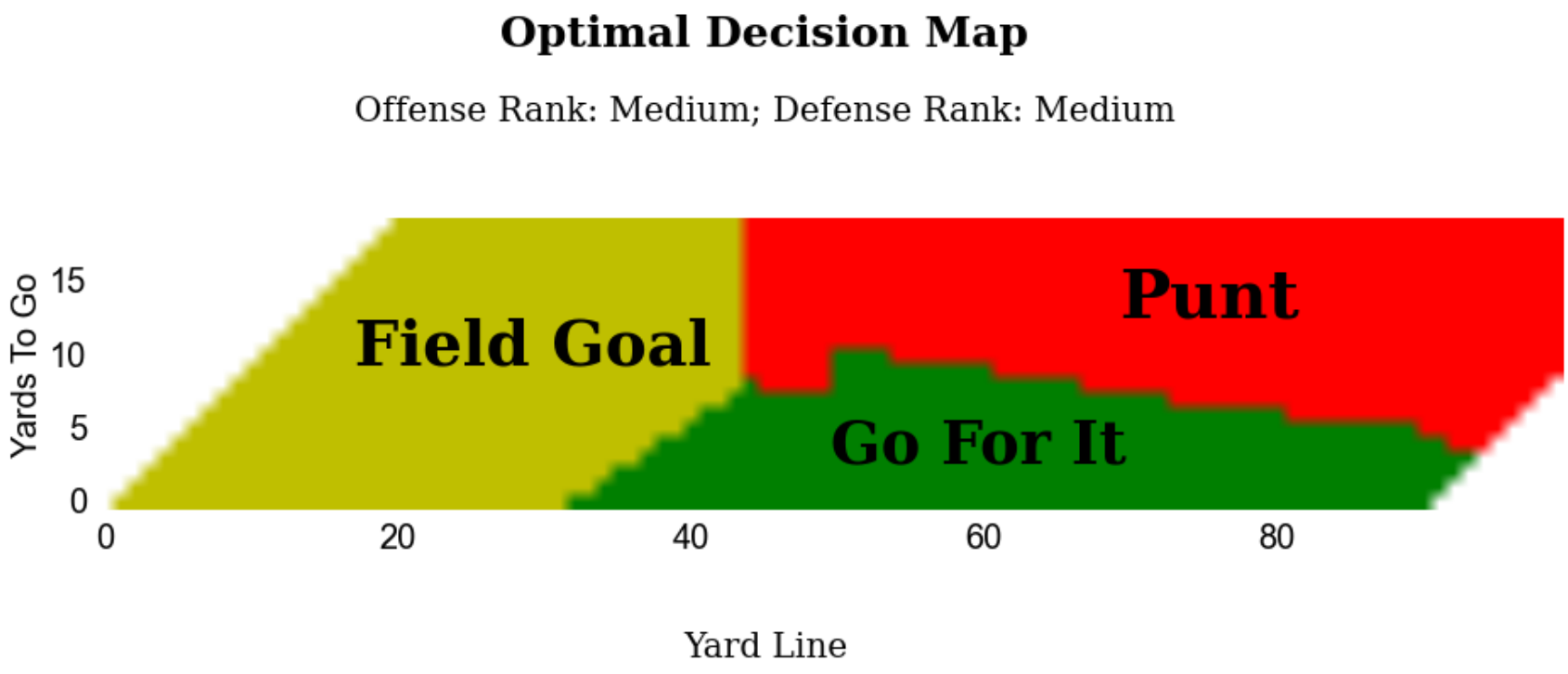
What should my decision be?



NFL Go For It!
What should my decision be?



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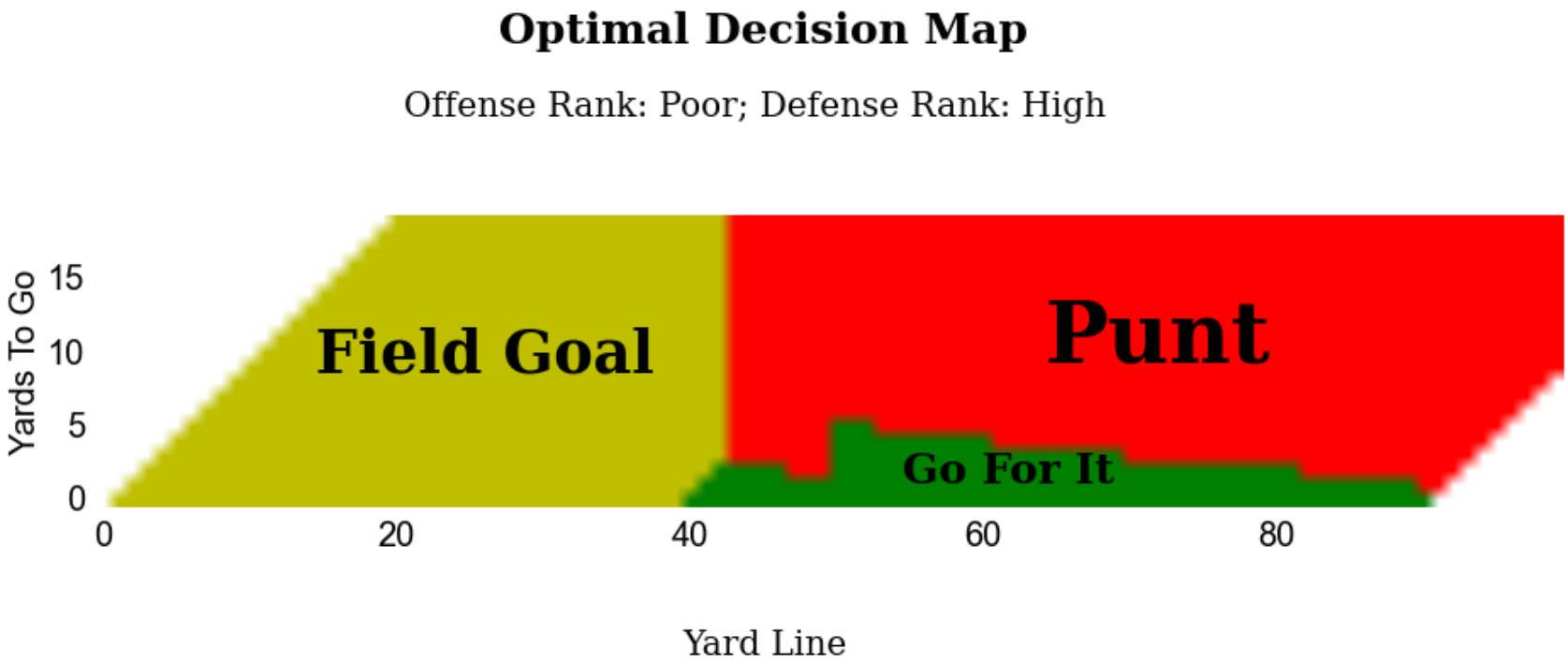

Thank You!