



# Historical 4<sup>th</sup> Downs and Win Probability Models in the NFL

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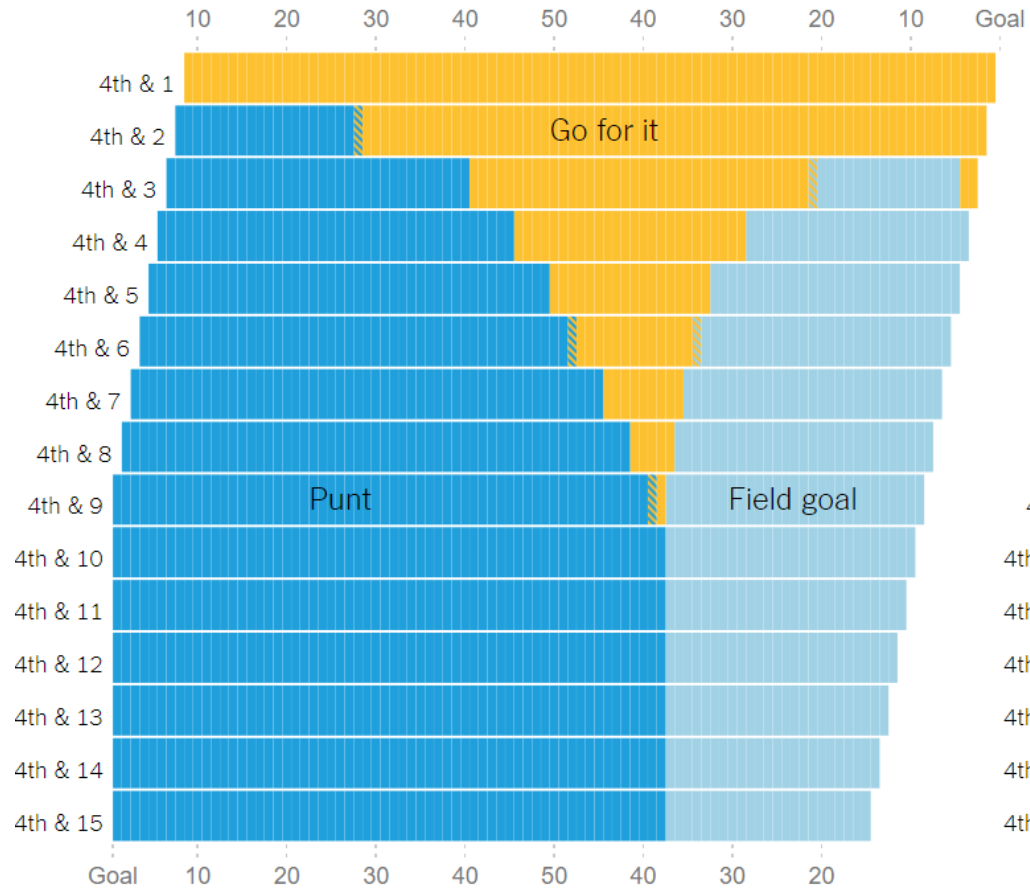
# Research

- Stern, H. (1991): “On the Probability of Winning a Football Game,” *American Statistician* 45(3): 179–83.
- Lopez, M. (2017): “All win probability models are wrong some are useful.”
- NYT 4th Down Bot (2014). “4<sup>th</sup> Down: When to Go for it and Why.” *The New York Times*.
- Romer, D (2002), "Do Firms Maximize?" *JPE* 114(2): 340-65.
- Quealy, K., T. Causey, and B. Burke (2017): “4th down bot: Live analysis of every N.F.L. 4th down.”
- Yurko, R.; Ventura, S.; and Horowitz, M (2019): “nflWAR: A reproducible method for offensive player evaluation in football.” *Journal of Quantitative Analysis in Sports* 15(3):163–183.

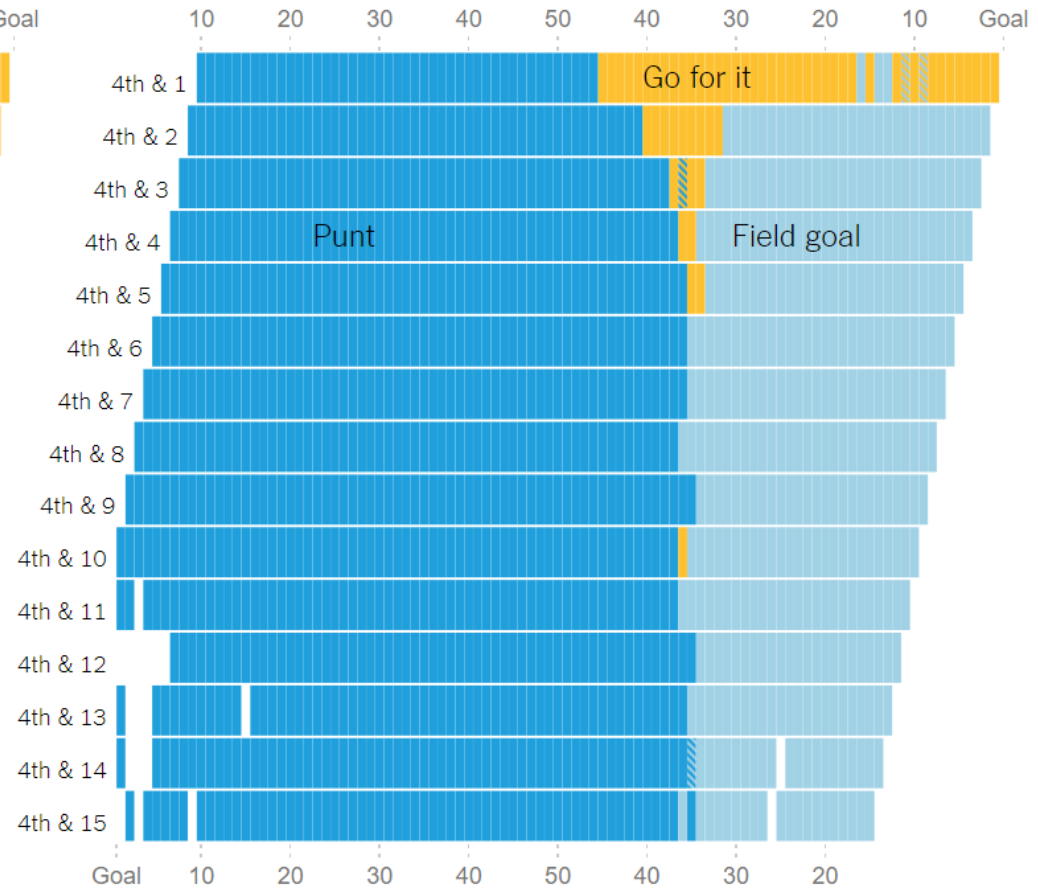


# NYT 4<sup>th</sup> Down Bot

WHAT NYT 4TH DOWN BOT RECOMMENDS ON 4TH DOWN



WHAT N.F.L. COACHES DO MOST OFTEN



# Collection Methods

- Pro-Football-Reference Play Index and nflscrapR PBP Data
- 4<sup>th</sup> downs with scoring margin between 21 points
  - No blowouts to skew data
- Every play given a specific, unique PlayID
- Cross-reference in Excel with nflscrapR Win Probability data



# Data

- Of the 31,206 4<sup>th</sup> downs in question, 29,713 “counted”
  - No penalty or extenuating circumstance to cancel out play
- Coaches followed NYT advice 76.4% of the time in total
  - Punt: Follows advice 94.8%
  - Field Goal: Follows advice 89.4%
  - When told to go for it: follows advice **29.5%**

NYT Rec	Go for it	FG	Punt	Total
Follows	2322	5523	14843	22688
Against	7870	6178	15665	29713
Percentage	29.5%	89.4%	94.8%	76.4%



# Outliers

- Extremely low/high win probabilities and late in half
  - Plays with a pre-play win probability of above 80% or below 20%, as well as all plays after the two-minute warning in either half are situation-dependent
- Coaches followed NYT advice 78.8% of the time in total
  - Punt: follows advice 99.0%
  - Field Goal: follows advice 95.6%
  - When told to go for it: follows advice **24.4%**
- Coaches are less inclined to go for it unless they are seemingly forced to by game conditions

NYT Rec	Go for it	FG	Punt	Total
Follows Rec	1073	3076	9068	13217
Total Plays	4393	3217	9157	16767
Percentage	24.4%	95.6%	99.0%	78.8%



# Win Probabilities

- In “close game scenarios”, win probability increases by roughly 3% per play
  - Punting increases win probability by ~4%
  - Kicking a field goal increases win probability by ~0.8%
  - Going for it increases win probability by ~2.9%
- In “close game scenarios” win probability increases by roughly 1.9% per play
  - Punting (when advised to do differently) increases win probability by ~2.2%
  - Kicking a field goal increases win probability by ~1%
  - Going for it increases win probability by ~2.8%

NYT Rec	Go for it	FG	Punt	Total
WPA Following NYT Rec	2.9%	0.8%	4.0%	3.1%
WPA Against NYT Rec	2.8%	1.0%	2.2%	1.9%

\*WPA = Win Probability Added



# Comparison

- When advised to punt, punting is the best decision
- Kicking a field goal is a low-reward situation compared to punting or going for it
- Going for it, whether advised or not, has higher average win probability added than kicking a field goal at any time or punting when advised against it





# Conclusion

- NYT Model was great for 2014 but is outdated
- 4<sup>th</sup> and 1s everywhere may be extreme, but aggressiveness in the middle of the field is a place to start
- Data is always evolving and models must follow newer data



# NYT Model

- Built in 2014, uses neutral game-script situations
- Static model built for league 5 years ago
- Needs updates with current league conditions and increased variables
  - Score of game and time remaining in game
  - Team/opponent strength
  - On-field personnel
  - Weather conditions
  - Location of game



# Questions

1. Does knowing how scripted the NFL is when it comes down to 4th down, frustrate you as someone who wants to work in the industry?

2. What will make the NFL embrace this aggressive style of going for it on 4th down more often?

