



NFL Group 1

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4th-Down Decision Making & Late-Game Strategy:

Analyze and improve 4th-down decision-making — especially late in games — by comparing actual choices (go/punt/FG) to data-driven recommendations and their impact on Win Probability (WP).

Data Collection

Key Inputs:

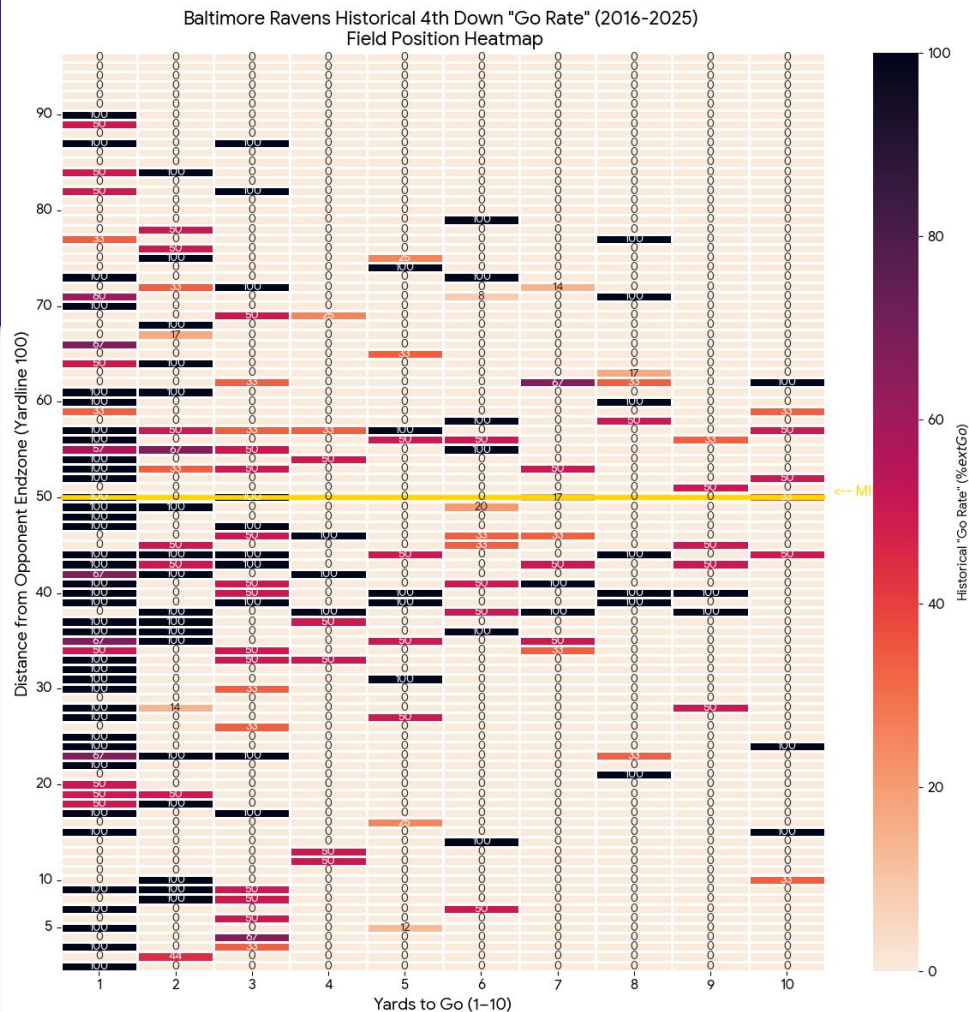
- Yards to Go
- Yardline
- Score Differential
- Wind speed
- Seconds Remaining in Game
- Quarter
- Offense/Defense strength

Note: Data was collected starting from the 2016 NFL season and goes up until week 6 of the current season. (nflverse-data repo)

Historical 4th Down Heatmap

Baltimore Ravens 4th Down Historical "Go Rate"

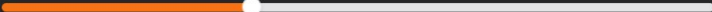
- Darker cells indicate a higher historical "Go Rate"
- The team is highly aggressive on 4th and short (1-2 yards to go) in the neutral field area (Yardline 100 in the 40s and 50s)
- The Go Rate drops immediately inside the opponent's 35-yard line (Field Goal Range) and deep in the Ravens' own territory (high Yardline 100 values).



4th Down Bot Base Case

Yardline (distance from opponent end zone)
Own 25 → 75, Midfield → 50, Opp 40 → 40, Opp 10 → 10

35 ↺

1  99

Quarter

2 ↺

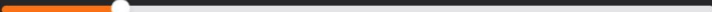
1  4

Time remaining (seconds, in game)

2000

Yards to go (for first down)

4 ↺

1  20

Score differential (Ravens - Opponent)
Positive = Ravens leading, Negative = Ravens trailing

3

Wind speed (mph, rough estimate)

5

Offense strength (0 = league average)
Positive = better offense, Negative = worse

0

Opponent defense strength (0 = league average)
Positive = better defense, Negative = worse

0

Compute Win Probabilities

Results

Win probabilities (Ravens):

- Go for it: 62.51%
- Field goal: 65.51%
- Punt: 61.33%

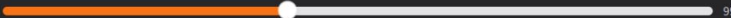
Recommended action:  Field goal

4th Down Bot High-Pressure Case

Yardline (distance from opponent end zone)

Own 25 → 75, Midfield → 50, Opp 40 → 40, Opp 10 → 10

40 ↺

1  99

Quarter

4 ↺

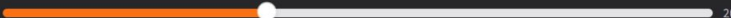
1  4

Time remaining (seconds, in game)

120

Yards to go (for first down)

8 ↺

1  20

Score differential (Ravens - Opponent)

Positive = Ravens leading, Negative = Ravens trailing

-3

Wind speed (mph, rough estimate)

5

Offense strength (0 = league average)

Positive = better offense, Negative = worse

0

Opponent defense strength (0 = league average)

Positive = better defense, Negative = worse

0

Compute Win Probabilities

Results

Win probabilities (Ravens):

- Go for it: 24.91%
- Field goal: 23.07%
- Punt: 20.00%

Recommended action: ● Go for it

Team Audit (2021-Present)

Analyzed all **4th downs** in key spots (redzone, midfield, score differential >10)

Conclusions:

- **Go rate:** (percent of plays the coach went for it)
 - 21.33%
- **Optimality Rate:** (percent to which the coaches decision matched our model)
 - 80.67%
- **Average WP Regret:**
 - 0.8%
- **Average EPA Regret:**
 - -0.055 expected points

Expanding to all 4th down plays, we can see 17.87% go rate vs. strong defense and 18.12% go rate vs. weak defense

Coaches vs Bot Decision Making

October 16th, 2016 (Ravens vs Giants):

- 4th Quarter (15:00) Giants 1 yd line (1 yd to go)
 - Score Differential: -4 (13-17)
 - Ravens Decision: Run (36.28%) (**Fail**)
 - Bot: FG (39.28%)

January 11th, 2020 (Ravens vs Titans):

- 3rd Quarter (10:01) Titans 18 yd line (1 yd to go)
 - Score Differential: -8 (6-14)
 - Ravens Decision: Run (19.60%) (**Fail**)
 - Bot: FG (21.06%)

Coaches vs Bot Decision Making Pt. 2

October 2nd, 2022 (Ravens vs Bills)

- 4th Quarter (4:15) Bills 2 yd line (2 yds to go)
 - Score Differential: 0 (20-20)
 - Ravens Decision: Pass (61.10%) (**Fail**)
 - Bot: FG (64.24%)

October 27th, 2024 (Ravens vs. Browns)

- 1st Quarter (8:48) Browns 7 yd line (1 yd to go)
 - Score Differential: 0 (0-0)
 - Raven's Decision: Run (55.25%) (**Fail**)
 - Bot: FG (58.25%)

Final Conclusions

4th Down WP Bot:

- The model tends to recommend safer choices
- WP Bot avoids unnecessary risks, especially early and mid-game, which helps reduce WP regret over large sample sizes.
- WP Bot does not take into account certain factors
 - Kicker range, play design, momentum

Coaches Decisions:

- Coaches match the model about 80% of the time, but the remaining 20% represents meaningful lost WP, especially when the decision is made in the red zone or under two minutes.
- Coaches do not typically consider opponent defensive strength
- They go against certain WP punt/field goal strategies to take more riskier “go for it” plays

Overall Takeaway:

- The optimal blend is not analytics or instinct, but a calibrated decision-making framework where data guides the strategy and intuition fine-tunes it

Thank you for Listening!

Q/A