

Creating a Model to Decide Overtime 4th Down Decisions

BSA Football Research



About the Dataset

Source: NFL play-by-play data via `nfl_data_py`

Seasons: 2016-2024 (15 seasons)

Scope: Filtered to all **4th down plays** (~35,800)

Key fields used across submodels:

- Game situation: yardline, yards to go, score difference, time remaining, quarter
- Play outcome: punt distance, kick result, first down/ touch down
- Team Performance: rolling 6-game averages, offensive EPA, punt accuracy, conversion rates

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Submodels

Field Goal Probability

Predicts the probability of making a field goal

Punt Outcome

Predicts where the opponent gets the ball after a punt

4th Down Conversion

Predicts the likelihood of converting a “go for it” attempt

Win Probability

Estimates a team's chance of winning given current game state

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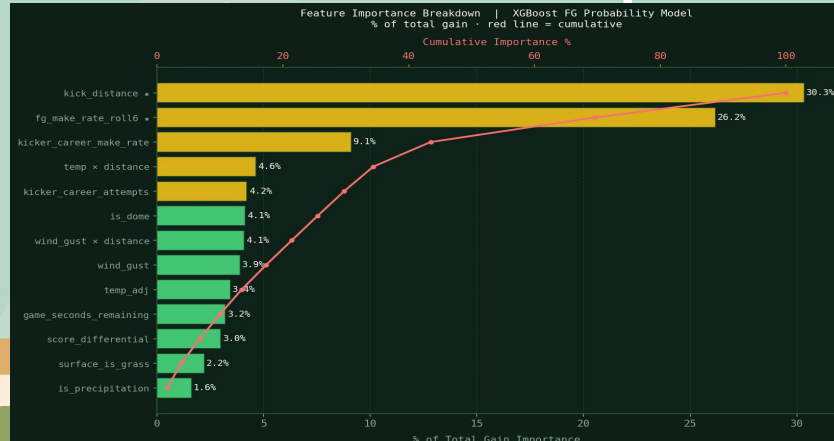
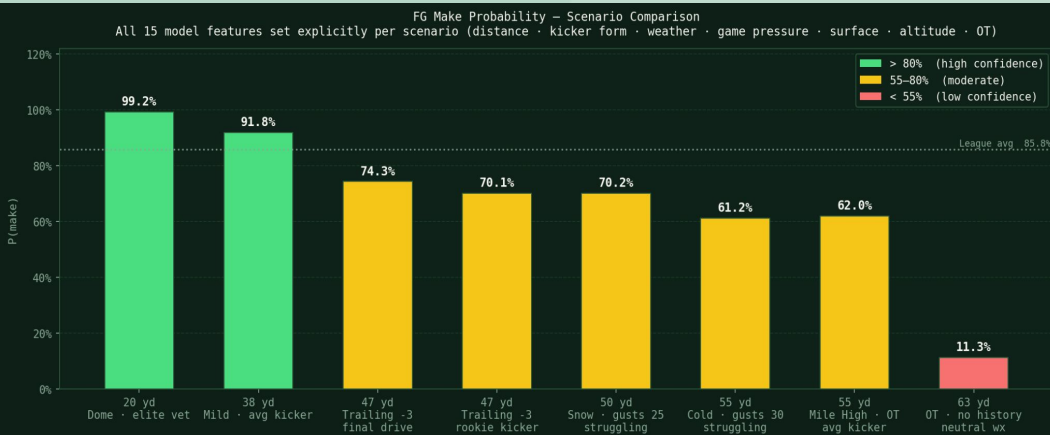
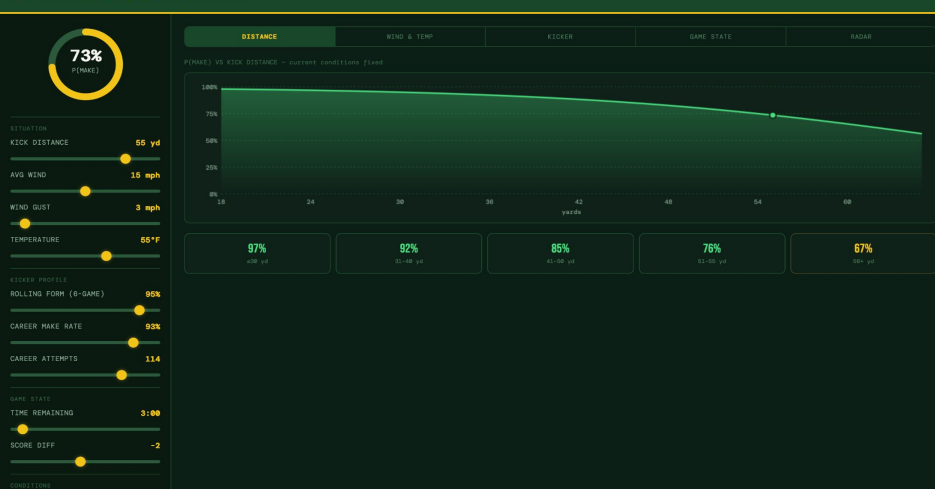
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Field Goal Probability Model

- Trained on every NFL field goal attempt from 2016–2024
- Takes in 14 inputs: kick distance, kicker's recent and career accuracy, weather (wind, temp, precipitation), stadium (dome, surface, altitude), and game situation (score, time, overtime)
- Outputs a probability of making the kick for any combination of conditions
- Distance matters most, but kicker form and weather contribute on close calls



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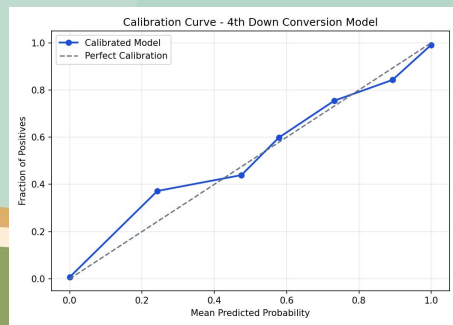
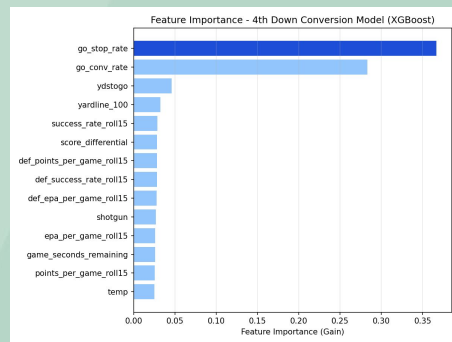
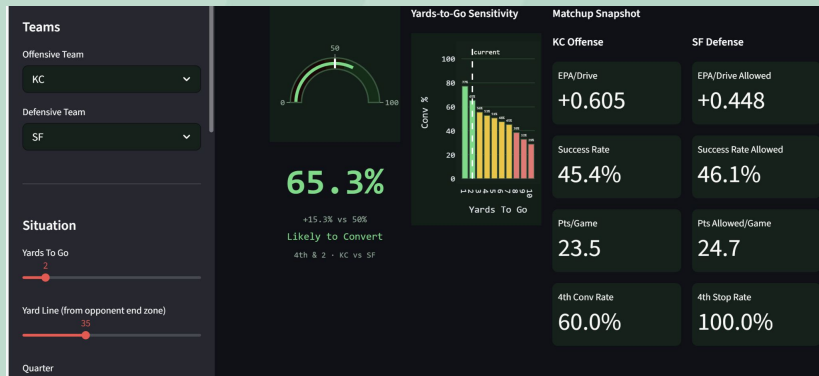
Fourth Down Conversion Model

Goal: Predict the likelihood of converting a 4th down attempt

Model: Game situation + 15-game rolling team stats → XGBoost model + empirical blending → conversion probability

Features & Performance:

- Game Context: Yards to go, field position, score, time remaining, team strength, etc
- The 3-7 Yard Gap: Blends raw model outputs with historical baselines, trading pure data accuracy for a strategically sound decision curve despite noisy inputs.



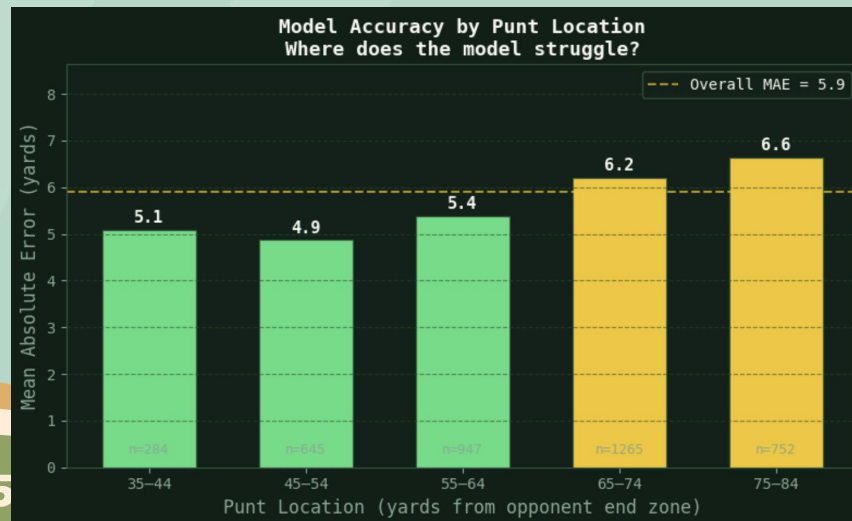
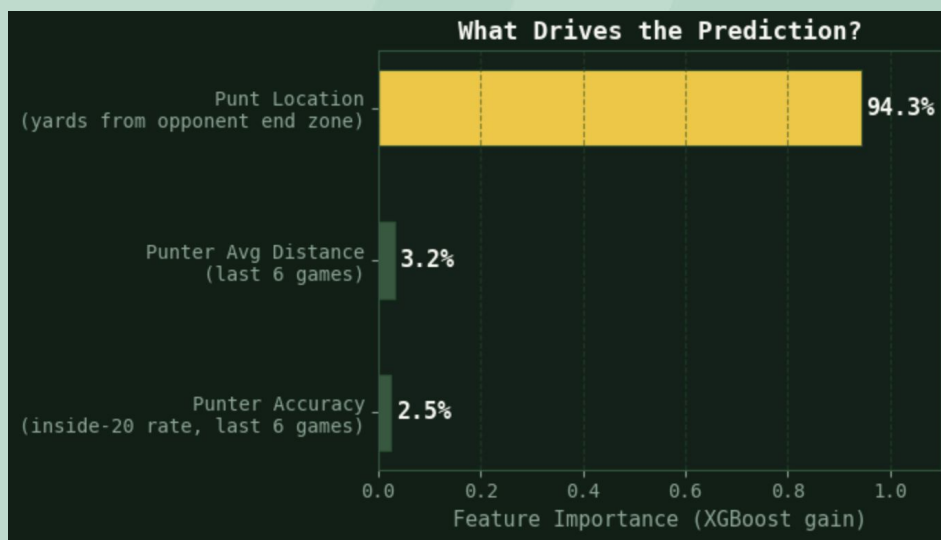
Punt Outcome Model

Goal: Predict where the opposing team will get the ball after a punt

Model: Punt location + punter quality → XGBoost model → predicted opponent starting field position

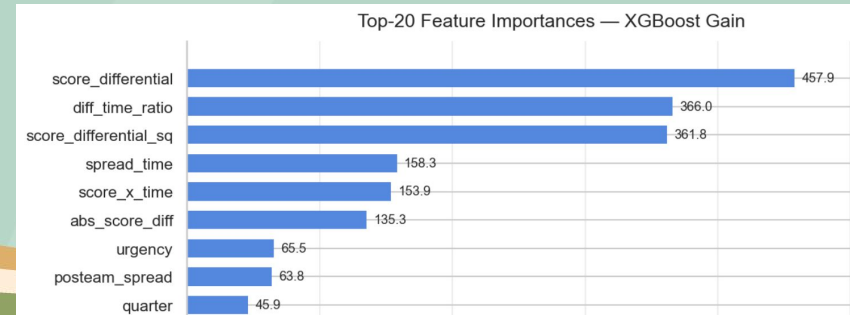
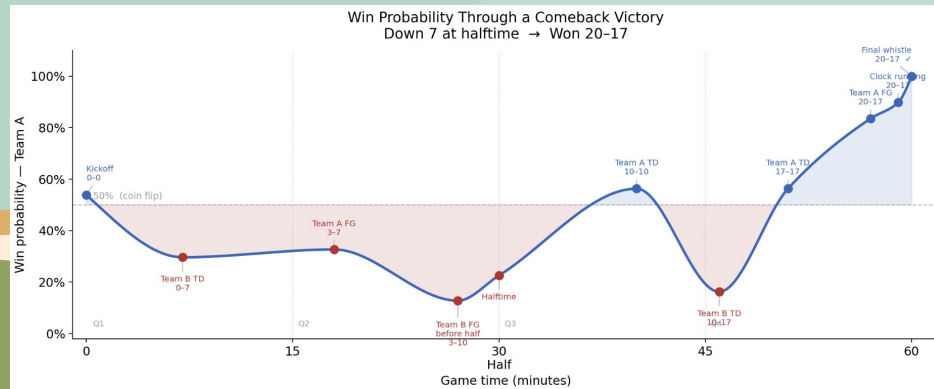
Features:

- Where on the field the kick is occurring
- 6-game rolling average punt distance
- 6-game rolling average inside-20-yard-zone-rate



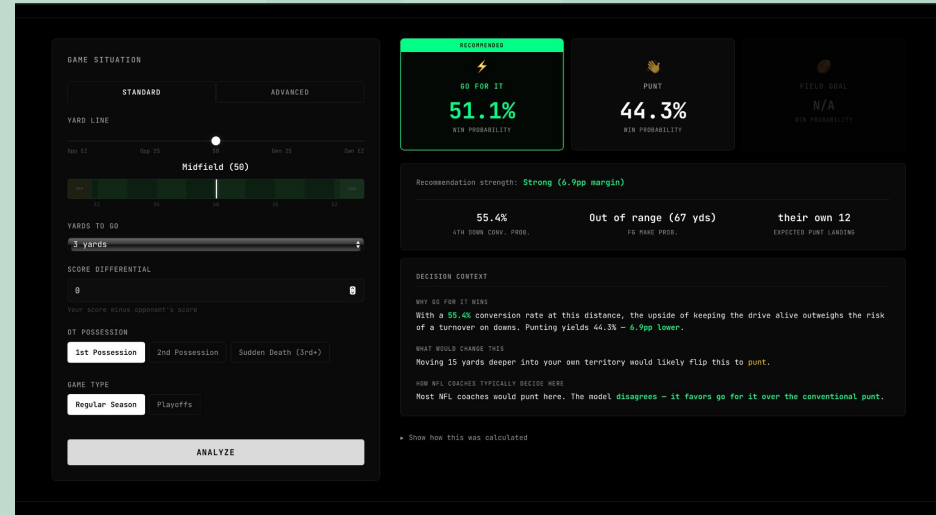
Win Probability Model

- Model input: Game state -> Output: Probability that offense wins game
 - Trained on all types of NFL plays to understand different game states
- On fourth-down, engine asks what's our WP if we go for it and convert? If we fail? If we kick a FG? If we punt? These values are fed from our other submodels and we return the decision that yields the highest WP
- For OT scenarios, we designed an OT transformer that compresses the overtime clock into a regulation-equivalent state that the model already understands



Final Model

- playbyplay.football
- Takes the outputs of all four submodels and calculates the expected win probability for each option
- Recommends the play that maximizes your team's chances of winning, along with a confidence level



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Future Plans

- Publish a research paper on our findings
- Update and fine tune the model each season as new data comes in
- Test predictions on live overtime games in the 2026–2027 NFL season

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