ONSIDE KICK ANALYSIS

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CONTENT

PROBLEM STATEMENT

PROBLEM STATEMENT: When should NFL teams perform an onside kick?

Experimental rule in 2021 made it easier for teams to recover onside kicks

- 4.9% in 2020, 17.3% in 2021

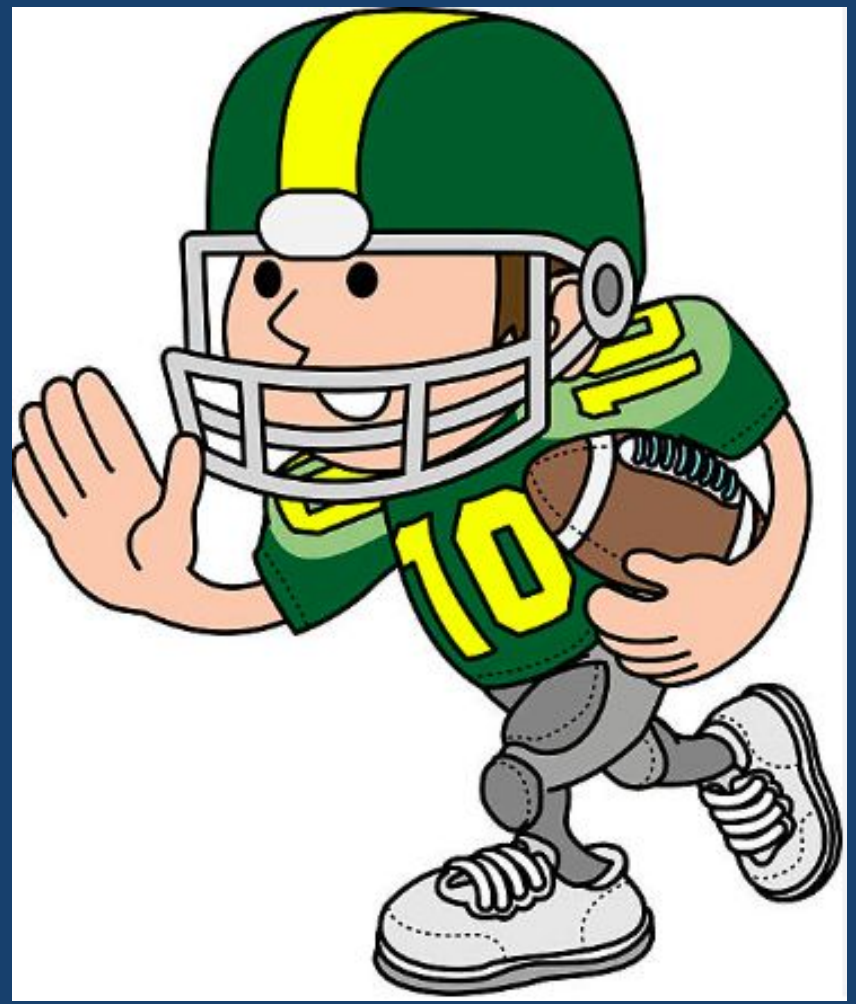
High risk for potentially high reward

Project goals:

- Understand luck vs. skill
- Predict determinants of recovery rate
- Determine what makes an onside kick worth it

WHAT IS AN ONSIDE KICK

QUICK NOTES



Definition

A kickoff that is deliberately kicked short in an attempt by the kicking team to regain possession of the ball.

Traits

- Begin on 35 yards from own goal
- Kicked short, but must travel at least 10 yards before recovering
- If the ball touches the receiving team, no limits for recovering
- **Often played by the end of the game in 4th quarter**

SUCCESSFUL ONSIDE KICK

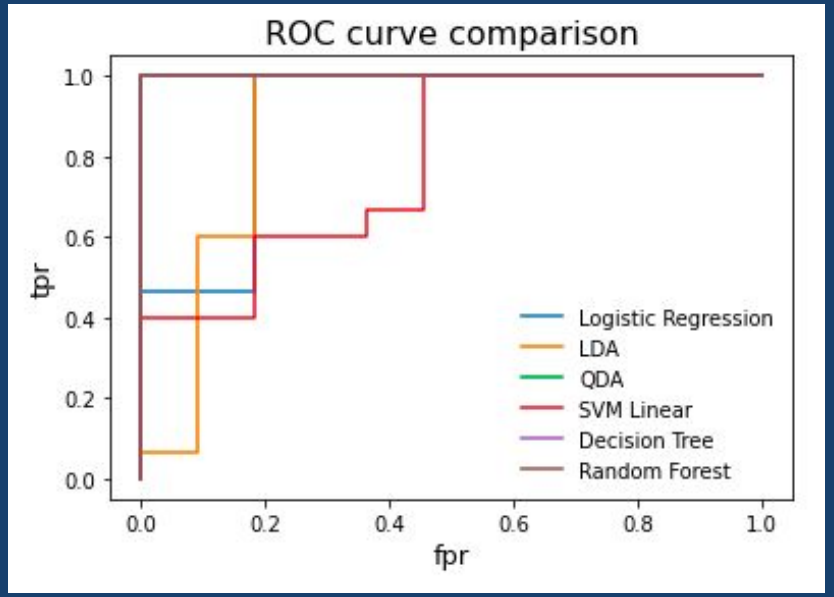
UNSUCCESSFUL ONSIDE KICK

RECOVERY REGRESSION

RECOVERY REGRESSION

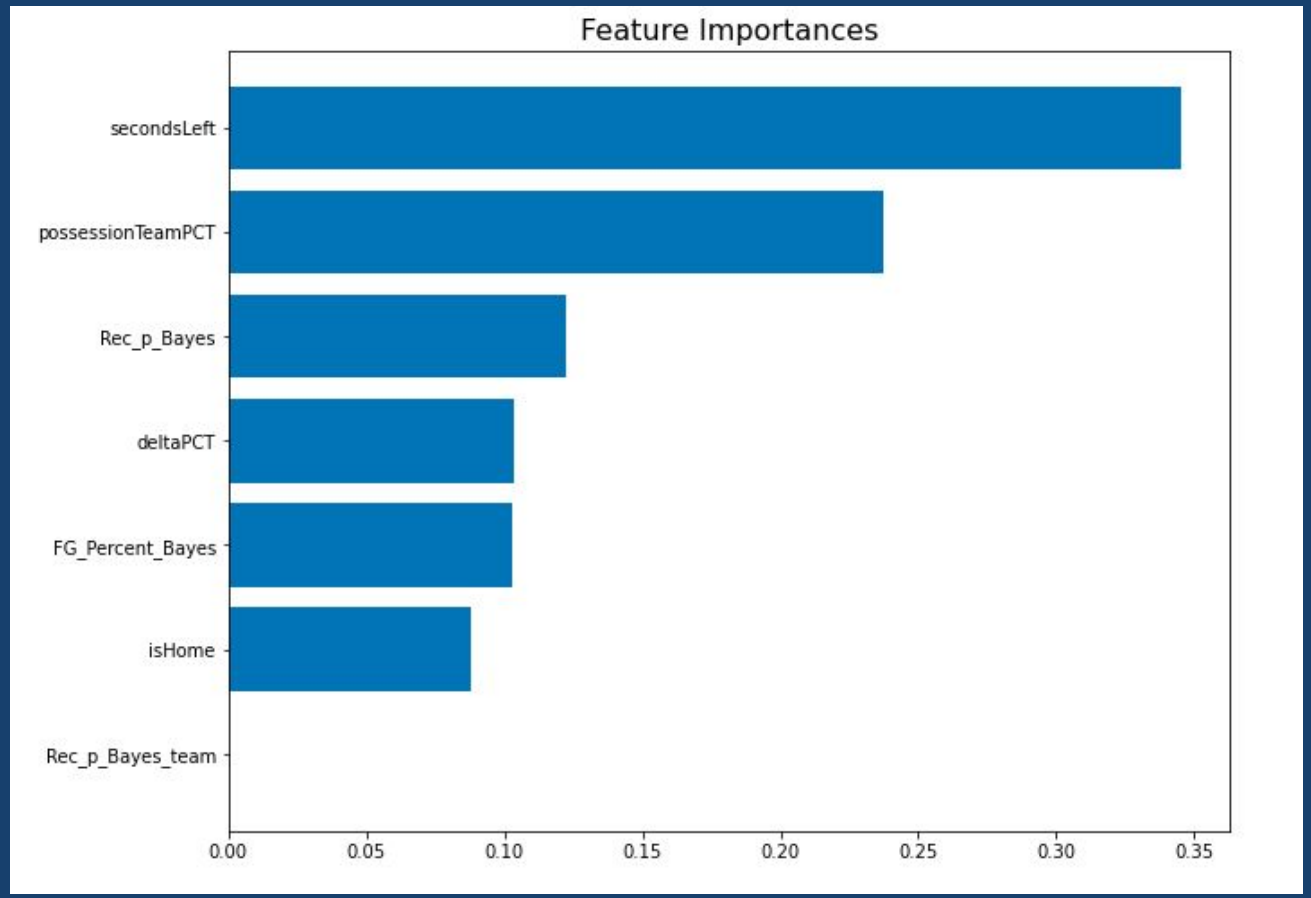
Data: 155 detailed records of NFL onside kicks

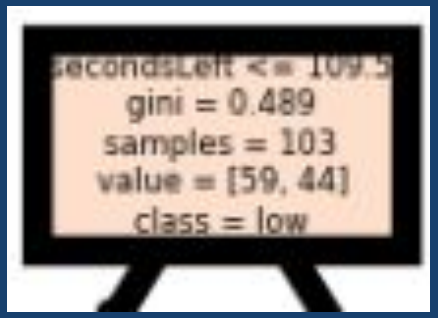
Variable	Description
isRecovery	Binary dependent variable, 1 for recovered
secondsLeft	Seconds left till the end of the quarter
isHome	Binary, 1 when the possession is the home team
possessionTeamPCT	Possession team's winning percentage, derived from the NFL's official standing
deltaPCT	The difference in the winning percentage between the possession team and the receiving team
Rec_p_Bayes	Running mean-reverted recovery rate for kickers. Running means we only use the data happening prior to the observation
Rec_p_Bayes_team	Running mean-reverted recovery rate for the possession team
FG_Percent_Bayes	Mean-reverted field goal percentage for kickers beyond 30 yards from own goal, representing the kicker's kicking skill



- Resampling for the unbalanced data
- 8:2 train-test split
- Tree model recommended

RECOVERY REGRESSION

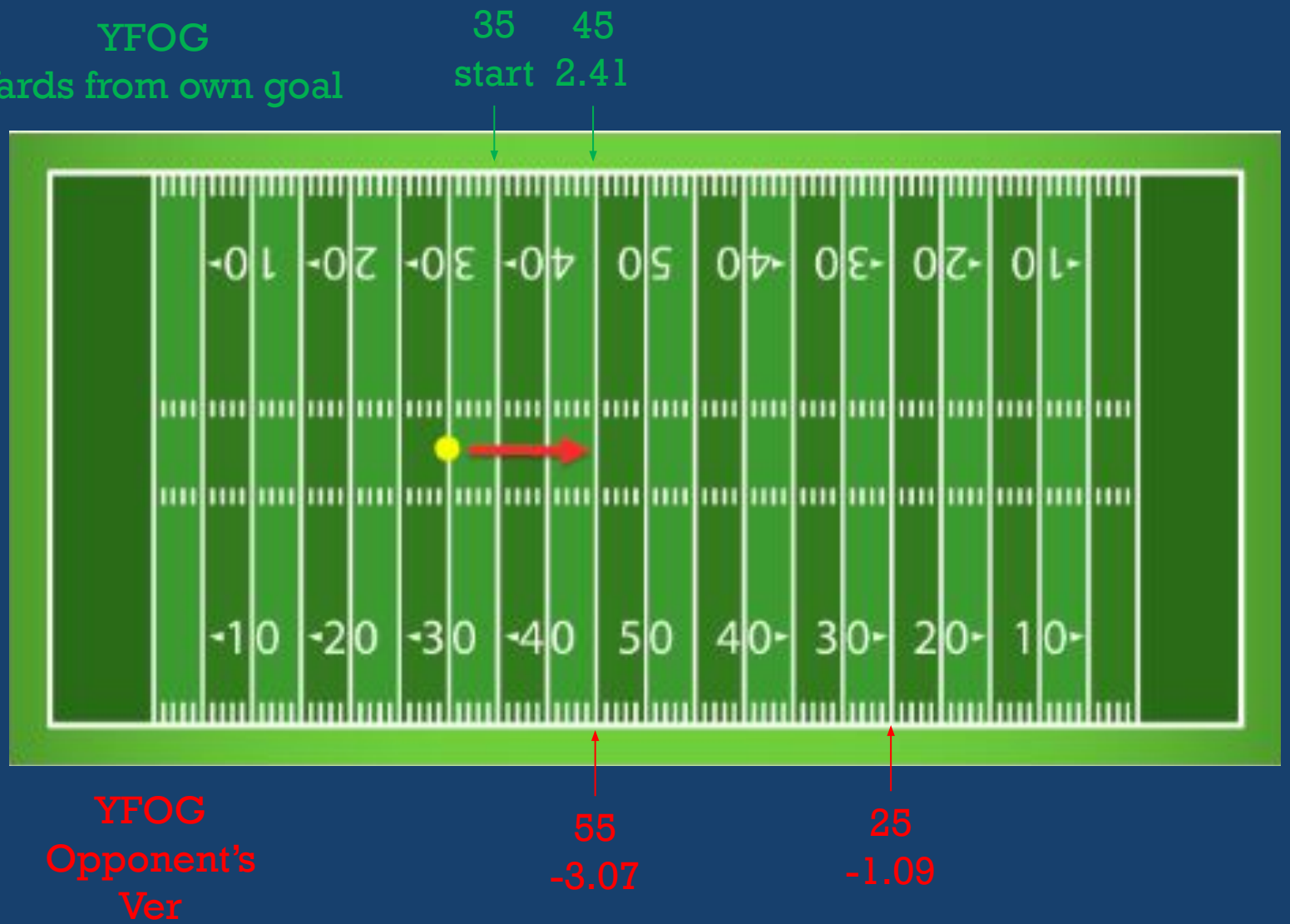




- The variable secondsLeft is the most important feature in our model
- Surprise Onside Kick cutoff: around 109.5 seconds left.

ONSIDE KICK STRATEGY

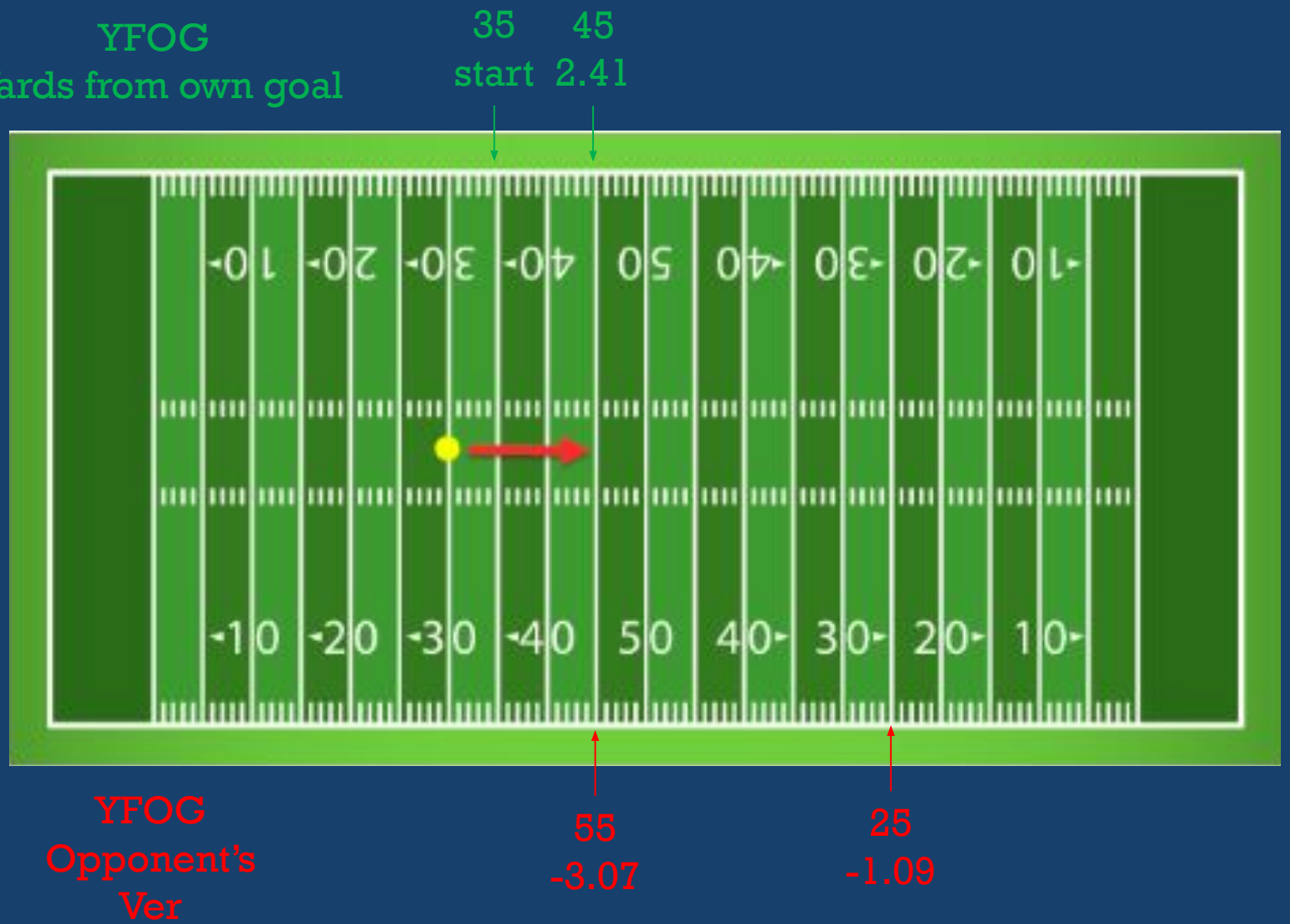
BREAK-EVEN RECOVERY RATE



Assumptions

- 10 yards assumption: for each onside kick, we assume it travels 10 yards, no matter recovered or not.
- EP (expected points): all the expected points are calculated from football_expected_points.xlsx
- For average level. When apply to the specific teams, EP may vary.

BREAK-EVEN RECOVERY RATE



EP Gained[1]

- **OSK Recovered:** 2.41 - (-3.07)=5.48
- **OSK Failed:** -3.07 - (-1.09)= -1.98
- **Break-even Rec%:** $\frac{1.98}{5.48-(-1.98)} = 26.54\%$

1. Method of getting Break-even Rec% reference: https://www.the33rdteam.com/category/breakdowns/the-analytics-behind-one-coachs-very-aggressive-tactics/

BREAK-EVEN RECOVERY RATE

Break-even Rec%=26.54%

Player	Onside Kickoffs	Onside Recovered	Rec%	std_dev	Bayes_Rec%
Cody Parkey	10	6	0.600000	0.489898	0.352135
Pat McAfee	9	4	0.444444	0.496904	0.268231
Younghoe Koo	6	3	0.500000	0.500000	0.256032
Mason Crosby	15	5	0.333333	0.471405	0.250443
Stephen Gostkowski	7	3	0.428571	0.494872	0.243739
Ka'imi Fairbairn	7	3	0.428571	0.494872	0.243739
Greg Zuerlein	6	2	0.333333	0.471405	0.204792
Austin Seibert	6	2	0.333333	0.471405	0.204792
Nick Novak	7	2	0.285714	0.451754	0.196195
Josh Brown	7	2	0.285714	0.451754	0.196195

Team	OSK	OSK Rec	Rec%	std_dev	Bayes_Rec%
Dolphins	22	7	0.318182	0.465770	0.221905
Packers	14	5	0.357143	0.479157	0.213081
Lions	30	7	0.233333	0.422953	0.193742
Falcons	25	6	0.240000	0.427083	0.192535
Bears	26	6	0.230769	0.421325	0.189017
Colts	15	4	0.266667	0.442217	0.188168
Patriots	9	3	0.333333	0.471405	0.187230
Texans	17	4	0.235294	0.424183	0.180531
Cowboys	21	4	0.190476	0.392677	0.165074
Giants	23	4	0.173913	0.379035	0.157530

Do not try onside kick? - Nope

- Try-or-lose
- Surprise onside kick may have higher recovery rate
- Adjust Eps for each team

LAST 240 SEC STRATEGY

Weighted Non-surprise OSK Rec%: 11.63%
Weighted Surprise OSK Rec%: 45.31%
Time cutoff: 120 sec
Time Sequence: 0, 40, 80, …, 240 sec

An Aggressive Coach

- If normal kickoff, lose 1 point w.p. 100%
- Onside kick lover
- No attempt, no miracle!

Optimal strategy						
Scope: 20	Time Remaing Secs			Cutoff		
Point Diff	240	200	160	120	80	40
9	Tie	Tie	Tie	Tie	Tie	Tie
8	Not OSK	Tie	Tie	Tie	Tie	Tie
7	Not OSK	Not OSK	Tie	Tie	Tie	Tie
6	OSK	Not OSK	Not OSK	Tie	Tie	Tie
5	OSK	Not OSK	Not OSK	Not OSK	Tie	Tie
4	OSK	OSK	Not OSK	Not OSK	Not OSK	Tie
3	OSK	OSK	OSK	Not OSK	Not OSK	Not OSK
2	OSK	OSK	OSK	OSK	Not OSK	Not OSK
1	OSK	OSK	OSK	OSK	OSK	Not OSK
0	OSK	OSK	OSK	OSK	Tie	OSK
-1	OSK	OSK	OSK	OSK	Tie	OSK
-2	OSK	OSK	OSK	OSK	OSK	OSK
-3	OSK	OSK	OSK	OSK	OSK	Tie
-4	OSK	OSK	OSK	OSK	OSK	Tie
-5	OSK	OSK	OSK	OSK	Tie	Tie
-6	OSK	OSK	OSK	OSK	Tie	Tie
-7	OSK	OSK	OSK	Tie	Tie	Tie
-8	OSK	OSK	OSK	Tie	Tie	Tie
-9	OSK	OSK	Tie	Tie	Tie	Tie
-10	OSK	OSK	Tie	Tie	Tie	Tie
-11	OSK	Tie	Tie	Tie	Tie	Tie
-12	OSK	Tie	Tie	Tie	Tie	Tie
-13	Tie	Tie	Tie	Tie	Tie	Tie

LAST 240 SEC STRATEGY

Weighted Non-surprise OSK Rec%: 11.63%
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Time cutoff: 120 sec
Time Sequence: 0, 40, 80, …, 240 sec

A Confident Coach

- If normal kickoff, lose 1 point w.p. 50%, and remain the same goal diff w.p. 50%
- The opponent is not that strong, we still have time to cover the spread, don't be anxious!

Optimal strategy						
Scope: 20	Time Remaing Secs			Cutoff		
Point Diff	240	200	160	120	80	40
9	Tie	Tie	Tie	Tie	Tie	Tie
8	Not OSK	Tie	Tie	Tie	Tie	Tie
7	Not OSK	Not OSK	Tie	Tie	Tie	Tie
6	Not OSK	Not OSK	Not OSK	Tie	Tie	Tie
5	Not OSK	Not OSK	Not OSK	Not OSK	Tie	Tie
4	Not OSK	Not OSK	Not OSK	Not OSK	Not OSK	Tie
3	Not OSK	Not OSK	Not OSK	Not OSK	Not OSK	Not OSK
2	OSK	OSK	Not OSK	Not OSK	Not OSK	Not OSK
1	OSK	OSK	OSK	OSK	Not OSK	Not OSK
0	OSK	OSK	OSK	OSK	Not OSK	Not OSK
-1	OSK	OSK	OSK	OSK	Tie	OSK
-2	OSK	OSK	OSK	OSK	Tie	OSK
-3	OSK	OSK	OSK	OSK	OSK	Tie
-4	OSK	OSK	OSK	OSK	OSK	Tie
-5	OSK	OSK	OSK	OSK	Tie	Tie
-6	OSK	OSK	OSK	OSK	Tie	Tie
-7	OSK	OSK	OSK	Tie	Tie	Tie
-8	OSK	OSK	OSK	Tie	Tie	Tie
-9	OSK	OSK	Tie	Tie	Tie	Tie
-10	OSK	OSK	Tie	Tie	Tie	Tie
-11	OSK	Tie	Tie	Tie	Tie	Tie
-12	OSK	Tie	Tie	Tie	Tie	Tie
-13	Tie	Tie	Tie	Tie	Tie	Tie

SUMMARY

Findings

- The **timing in onside kick is important**. A surprise onside kick has higher recovery rate;
- Onside kick has a relatively high break-even recovery rate.
- We've built a model for the **last 240 second strategy.** The result may vary due if we hold different attitudes towards our team and the opponent team.

Limitations

- Onside kick is a rare play, so we have small dataset. More observations are needed to update the conclusions;
- We calculated the expected points, weighted recovery rate and other stats based on the data and information collected. Changes may happen if the matrix is updated.

Appendix: Luck vs Skill

SPECIALIZED KICKERS?

Bayes Theorem + Linear Regression

Player	Onside Kickoffs	Onside Recovered	Rec%	std_dev	Bayes_Rec%
Cody Parkey	10	6	0.600000	0.489898	0.352135
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Bayes_Rec% ~ Rec%

Coef	**0.8235**
R-squared	0.893

- 10 year (2012~2021) dataset from NFL official website
- Top 10 Onside Kicker based on Bayes_Rec%

TEAM: LUCK VS SKILL

Bayes Theorem + Linear Regression

Team	OSK	OSK Rec	Rec%	std_dev	Bayes_Rec%
Dolphins	22	7	0.318182	0.465770	0.221905
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Bayes_Rec% ~ Rec%

Coef	**0.9384**
R-squared	0.998

- 10 year (2012~2021) team data from NFL official website
- Top 10 Onside Kick team based on Bayes_Rec%

LUCK VS SKILL

WLS Regression Results

Dep. Variable:	Percentage_Recovered_Bayes	R-squared:	
Model:	WLS	Adj. R-squa	
Method:	Least Squares	F-statistic:	
Date:	Fri, 02 Dec 2022	Prob (F-stat	
Time:	20:22:21	Log-Likelih	
No. Observations:	103	AIC:	
Df Residuals:	101	BIC:	
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	
Intercept	0.0243	0.002	9.853	
Percentage_Recovered	0.8235	0.013	65.071	

Omnibus:	91.236	Durbin-Watson:	
Prob(Omnibus):	0.000	Jarque-Bera (JB):	
Skew:	-2.719	Prob(JB):	
Kurtosis:	18.683	Cond. No.	

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THANK YOU!