The Anatomy of Temple's Success

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BIG PICTURE

Quantifying a **WIN**

Quantifying Chances of a Win

- Attempt to understand the chances of success beyond just points
- Here we define success as a win
- Develop a model to estimate the probability of a win using factors such as:
    - Score , Time remaining, Field Position, Downs and Distance till first down, Home Field Advantage, Weather, Injuries & Favorites
- Model ran after every play

Creating a Model

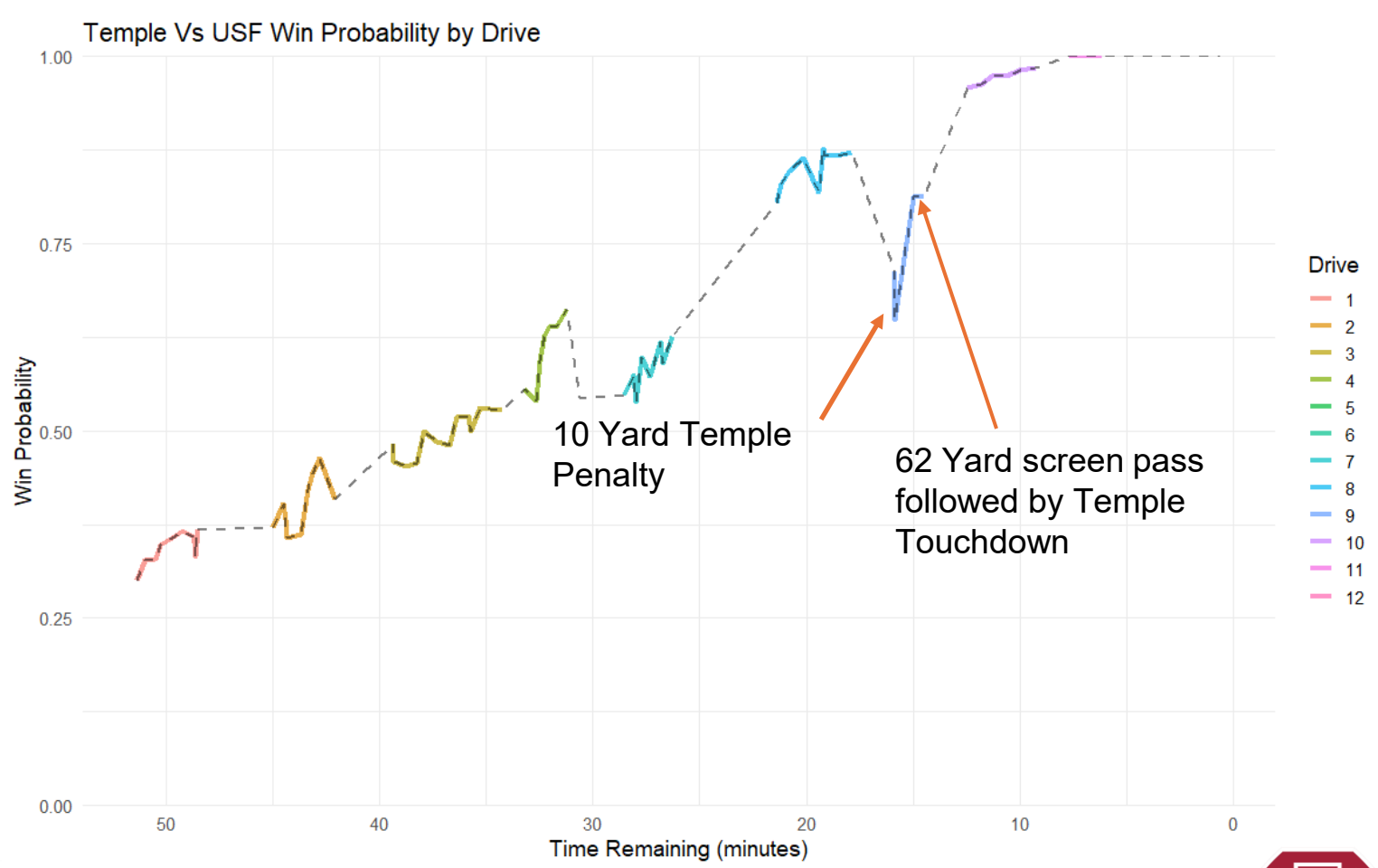
- Assumed final margin of victory is a normal distribution with a:
  - Mean = Vegas Spread
  - Standard deviation of m
  - m = Favorite's points – Underdog's points – Spread
    - Aka (Actual Margin – Expected Margin)
- σ_m = 18.41247
- Similar to NFL models where σ_m is around 13 -14
- College football often has higher scoring games with larger margins

$$P_{Home\ Win} = 1 - \Phi\left(\frac{-[+(M + EP) + 0.5 - \mu_{time}}{\sigma_{time}}\right)$$

Φ	Standard Normal CDF: Returns probably of a normal variable ≤ x
M	Scoring Margin = Home Score – Away Score
EP	Expected Points
0.5	Half point correction: CFB scores are integers, NORM.DIST is continuous >.5 models the rule of winning by 1
μ_{time}	$-(Home\ Vegas\ Line)\left(\frac{Time\ Remaining}{60}\right)$: Linear time scaled expected mean margin
σ_{time}	$\sigma_t = \frac{18.4126}{\sqrt{60/Time\ Remaining}}$: Linear time scaled standard deviation of scoring margin

Game of Probability

- Model able to calculate win probability throughout the game
- Also able to calculate the net probability added or lost by an offensive drive



Drive Probability Added

- Drive win probability added (DWPA)
  - Sum of Win Prob Added per drive
- Successful Drives
  - Drives that have net positive DWPA
- Generally, increased Mean DWPA as number of plays increases
- Variation may be because of low n

Plays In Drive	Mean DPA	% of Drives with Positive DPA
1	-13.2%	41.7%
2	4.94%	80.0%
3	-3.35%	28.9%
4	1.85%	52.2%
5	3.38%	56.2%
6	0.646%	50.0%
7	-0.85%	42.9%
8	7.53%	54.5%
9	1.14%	33.3%
10	7.27%	77.8%
11	3.16%	75.0%
12	14.3%	83.3%
13	4.77%	100.0%
14	4.34%	33.3%

DWPA Linear Regression With Number of Plays in Drive

- p-value =0.000123
- High significance that more plays in drive increases DWPA
- Each additional play in a drive increases DWPA by 1.329%
- Intercept of -6.538%
- Means that drives with fewer than 5 plays tent to lose DWPA

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Call:
lm(formula = DriveProbAdded ~ PlaysInDrive, data = drive_dat)

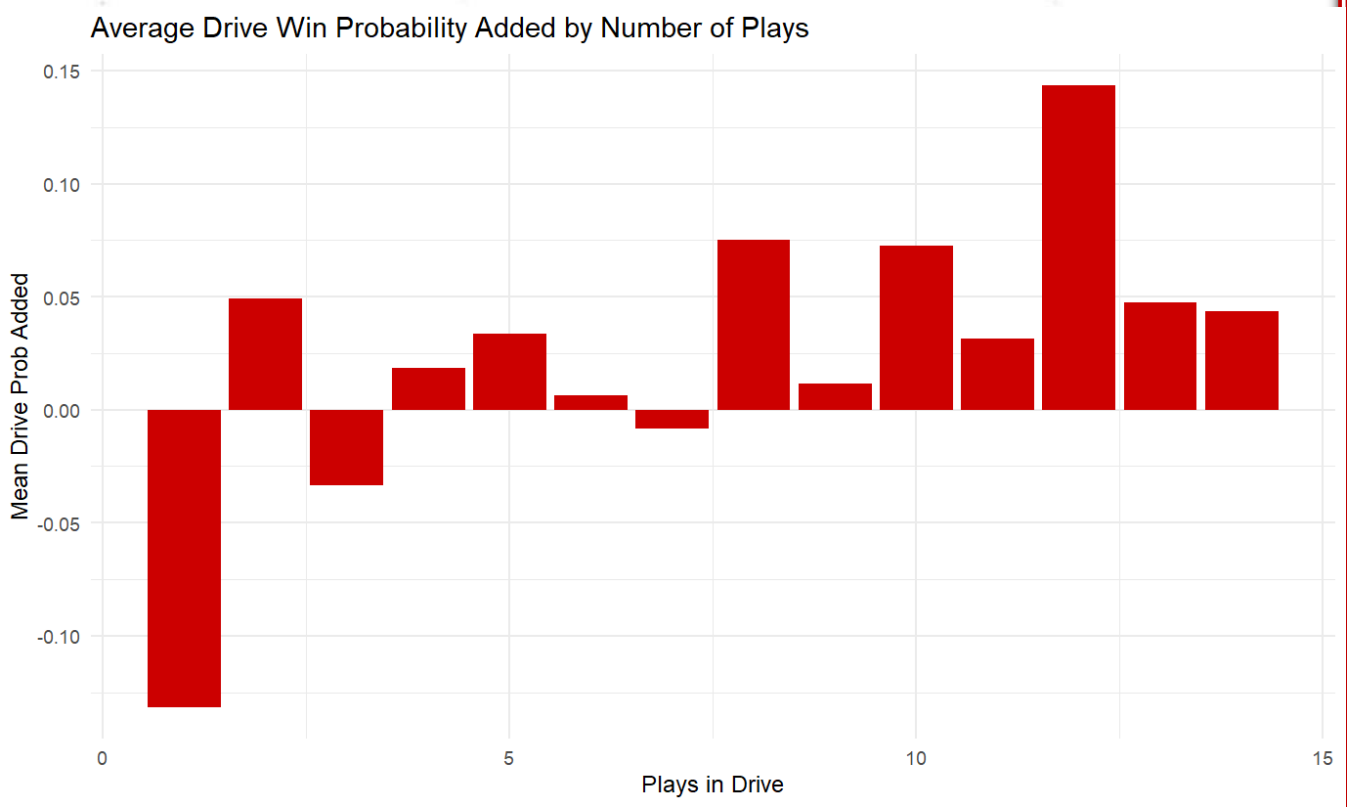
Residuals:
     Min       1Q   Median       3Q      Max
-0.78612 -0.03019  0.01101  0.04401  0.41712

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  -0.06538    0.02154  -3.035 0.002835 **
PlaysInDrive  0.01329    0.00337   3.942 0.000123 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.1367 on 150 degrees of freedom
  (1 observation deleted due to missingness)
Multiple R-squared:  0.09389,   Adjusted R-squared:  0.08785
F-statistic: 15.54 on 1 and 150 DF,  p-value: 0.0001234
```

Analysis of DWPA by Length

- 1-3 Plays
  - Often three and outs
  - Turnovers
  - Often resulting in good field position for opponent
- 5+ Plays
  - Shows sustained drives
  - More likely to get points
  - If they punt, it sets up good position for the defense to make a stop



How Do Wins Affect Recommendations?

- Here we place the weight of success on a win
  - Temple only won three games in 2022
- What is the win variation of this 2022 Temple team?
- Recommendations to a struggling team may be:
  - Stop current strategies and try new ones
- While Recommendations to a bowl team may be:
  - To fully buy in on existing strategies

Expected Wins

- Ran a Monte Carlo simulation
- Turned Temple spread of each game into a win probability
- With 10,000 simulated seasons

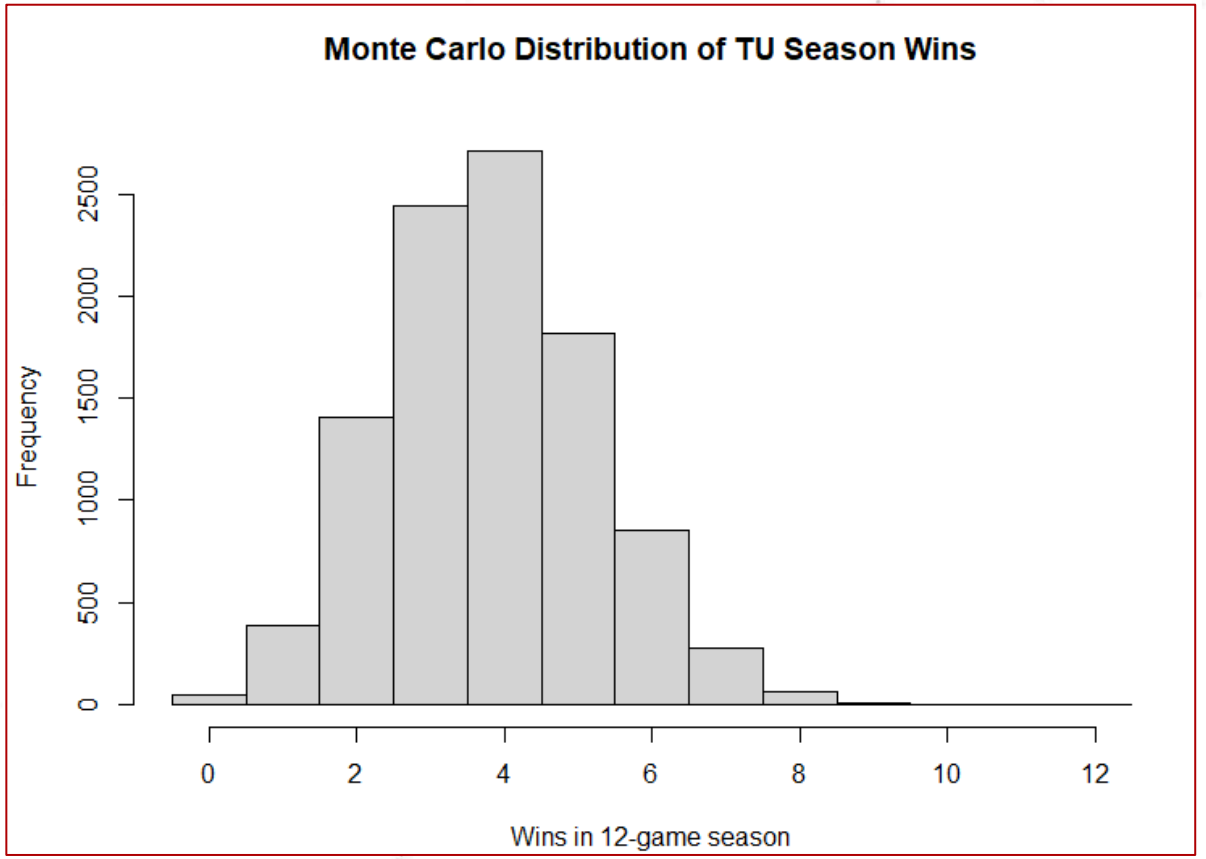
$$P_{Win} = \Phi\left(\frac{Temple\ line + 0.5}{18.41216}\right)$$

Expected Wins Cont'd.

- Temple Mean x Wins = 3.8033
- Very Close to actual 3 wins

Wins	Probability
0	49
1	387
2	1403
3	2437
4	2710
5	1816
6	851
7	279
8	63
9	4
10	1

Wins	Probability
No Wins	0.49%
At least 1	99.51%
At least 2	95.64%
At least 3	81.61%
At least 4	57.24%
At least 5	30.14%
At least 6	11.98%
At least 7	3.47%
At least 8	0.68%
At least 9	0.05%
At least 10	0.01%



Looking Deeper: Factors That Lead to Offensive Success

How is "Success" Measured?

Success rate is defined as the percentage of plays that meet the criteria for a "Successful Play", where a play is considered successful if it:

- Gains at least 40% of the needed yards (Distance) on 1st down
- Gains at least 60% on 2nd down
- Gains all (100%) of the needed yards on 3rd or 4th down

Total Success Rate = 39.21% (329 of 839 total plays were deemed successful)

"Success" = Pass, Shotgun, Specialized Personnel, Reduced Pressure

Factors that increase success:

- Passing plays vs. running: +14%
- Shotgun formation: +13%
- Specialized offensive personnel: +11%

Factors that decrease success:

- Later downs: -5% per down
- Longer distance to first down: -2% per yd
- QB under pressure: -10%

```
Call:
lm(formula = SUCCESS ~ DOWN + DISTANCE + RUN_PASS + SHOTGUN +
    OFF_PERSONNEL_GROUP + QB_PRESSURE + SCORE_DIFFERENTIAL +
    QUARTER, data = SuccessTemple)

Residuals:
    Min      1Q  Median      3Q     Max
-0.8034 -0.3886 -0.2958  0.5442  0.8438

Coefficients:
                     Estimate Std. Error t value Pr(>|t|)
(Intercept)        -0.7575192  0.3786827  -2.000 0.045788 *
DOWN               -0.0541859  0.0212741  -2.547 0.011047 *
DISTANCE           -0.0177148  0.0049509  -3.578 0.000367 ***
RUN_PASSP           0.1385413  0.0396697   3.492 0.000505 ***
SHOTGUN             0.1312163  0.0638416   2.055 0.040164 *
OFF_PERSONNEL_GROUP 0.1063359  0.0300940   3.533 0.000433 ***
QB_PRESSURE        -0.0977688  0.0462694  -2.113 0.034901 *
SCORE_DIFFERENTIAL  0.0006382  0.0013074   0.488 0.625579
QUARTER             0.0060956  0.0156021   0.391 0.696127
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.4794 on 815 degrees of freedom
  (9 observations deleted due to missingness)
Multiple R-squared:  0.05118,   Adjusted R-squared:  0.04187
F-statistic: 5.495 on 8 and 815 DF,  p-value: 8.881e-07
```

(Note: Temple ran 91% of their offensive plays in Shotgun formation)

Longer Drives = More Plays = Success

- The Baseline is:
  - A pass play on a drive vs a base package with 0 Temple timeouts
- A run play in a drive results in 0.60 less plays
- Each time out adds .4380 plays
- Against nickel defenses drive length increases by 0.6974 plays

```
Call:
lm(formula = DRIVE_PLAY ~ RUN_PASS + TIME_OUTS_REMAINING_OFFENSE +
    DEF_PACKAGE, data = dat)

Residuals:
    Min      1Q  Median      3Q     Max
-3.7595 -2.1588 -0.7595  1.6784  9.9378

Coefficients:
                             Estimate Std. Error t value Pr(>|t|)
(Intercept)                    2.7482     0.4742   5.796 9.72e-09 ***
RUN_PASSR                     -0.6007     0.2090  -2.874  0.00416 **
RUN_PASSX                      6.3758     2.8894   2.207  0.02762 *
TIME_OUTS_REMAINING_OFFENSE    0.4380     0.1503   2.915  0.00366 **
DEF_PACKAGEDIME                0.6037     0.5092   1.186  0.23615
DEF_PACKAGENICKEL              0.6974     0.2490   2.800  0.00522 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 2.878 on 815 degrees of freedom
  (18 observations deleted due to missingness)
Multiple R-squared:  0.02992,   Adjusted R-squared:  0.02397
F-statistic: 5.027 on 5 and 815 DF,  p-value: 0.0001523
```

What to Change?

game	run_tds in RZ	pass_tds in RZ	total_tds	redzone_runs	redzone_passes	total_redzone_plays	Run TD%	Pass TD%
Cincinnati	0	0	0	0	1	1	0%	0%
ECU	1	2	3	4	8	13	25%	25%
Houston	1	3	4	7	14	21	14.29	21.43
Lafayette	2	2	4	5	4	9	40%	50%
Memphis	0	0	0	1	4	5	0%	0%
Navy	0	1	1	4	10	14	0%	10%
Rutgers	1	0	1	3	0	3	33%	0%
Tulsa	0	0	0	3	5	8	0%	0%
UCF	0	1	1	3	3	6	0%	33%
UMass	1	1	2	5	2	8	20%	50%
USF	1	1	2	10	7	20	10%	14.90%

RedZone Success

Temple was more successful and more efficient in scoring in the red zone when passing the ball

- Higher pass TD% in 6 of 11 games compared to only having a higher run TD% in 1

Suggestions:

- Shift to a more pass first offense in red zone
- Need more creative scheming in the red zone when running the ball, as they were not very successful, this would open room for more creative schemes in the pass game and lead to less predictability

Personnel Recommendations

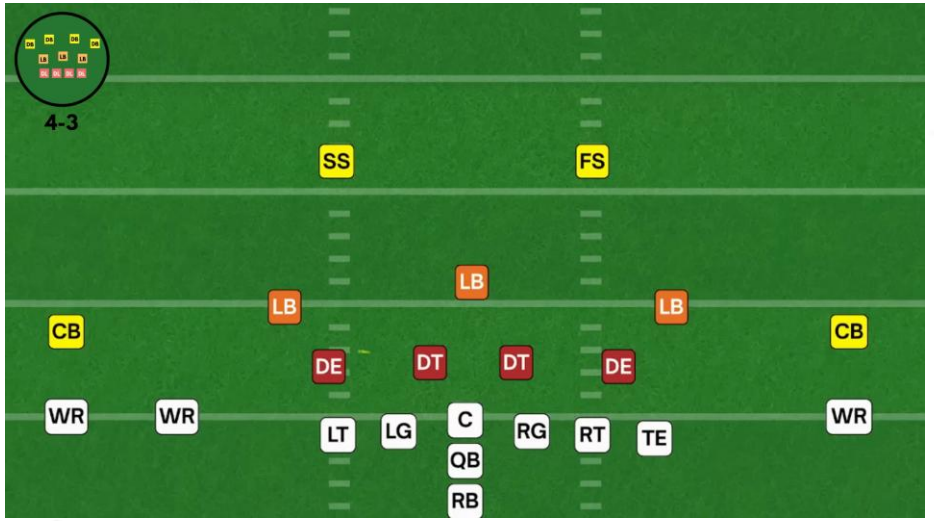
- Regression shows as personnel increases, play success also increases(reaching yard quota on play)
- 13 personnel, often a run heavy formation but sets up play-action passes
- Play action passes are often run from shotgun formation, which has a +.06 regression coeffect
- When the QB is pressured play success decreases by -0.09
- Using 13 personnel provides extra TE's to be used in protection

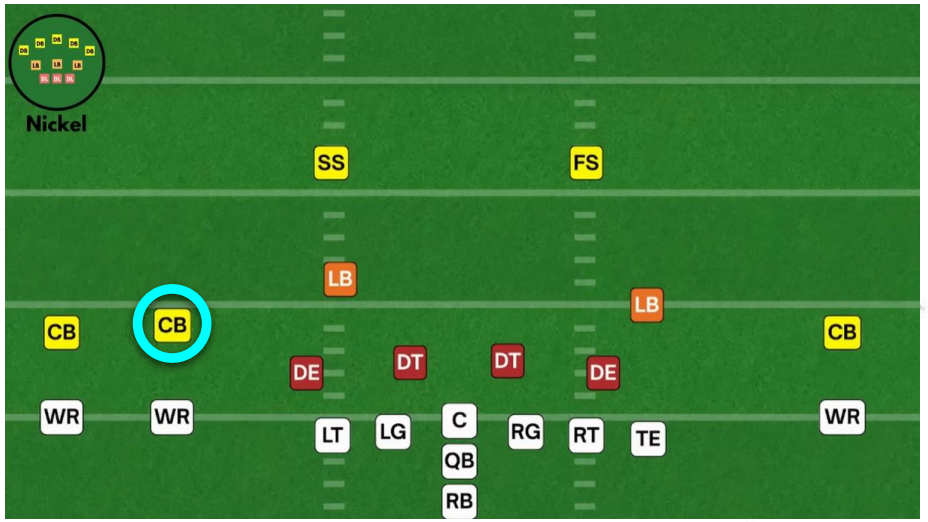
Lengthening Drives

- Drive length regression shows that passing, holding timeouts and beating nickel allows for longer drives
- Longer drives increase DWPA
- Holding timeouts allows for more strategic use
  - However, use of timeouts may represent mistakes or a trailing team
- Passing offences see more nickel defense

Defensive Sets

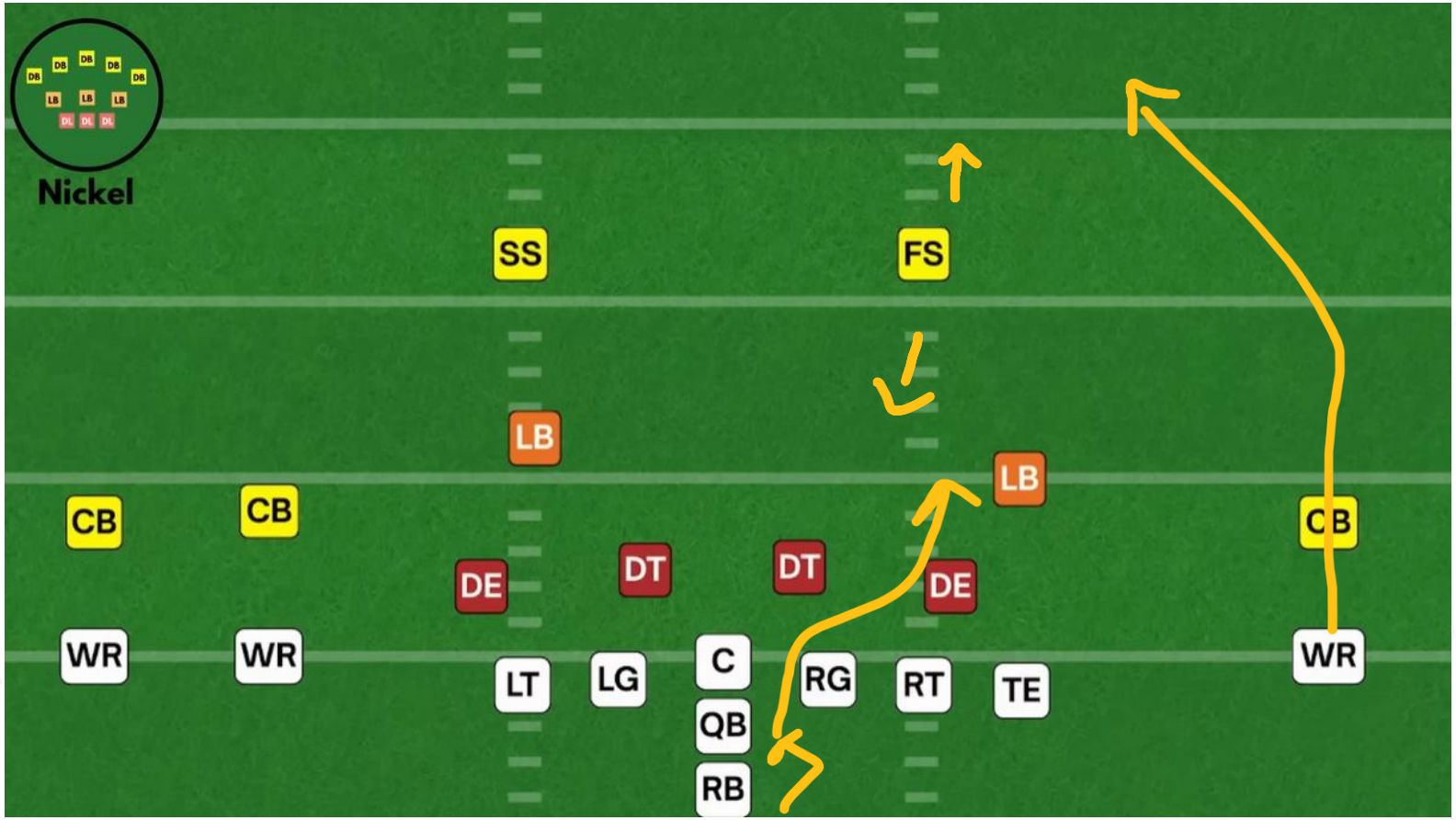
- Base defense was categorized by 4 DBs (Yellow)
- Nickel uses a 5th DB to cover the pass more effectively
- Opponents will play nickel vs. pass offenses (Shotgun formation)





Take Advantage of Nickel

- RPO vs Nickle
- Watch the FS



Thank you!

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