NFL Punt Analytics Competition

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Advancement on Fair Catch

Proposed Rule Change:

Edit to Rule 10, Section 2, Article 4:

ARTICLE 4. PUTTING BALL IN PLAY AFTER FAIR CATCH. After a fair catch is made, or is awarded as the result of fair-catch interference, the receiving team has the option of putting the ball in play by either a:

(a) fair-catch kick (drop kick or placekick without a tee) from the spot of the catch (or the succeeding spot after enforcement of any applicable penalties) (3-10 and 11-4-3), or

(b) snap from 10 yards in advance of the spot of the catch (or the succeeding spot after enforcement of any applicable penalties).

Step 1: Data Preprocessing

1. Loaded data from Kaggle-provided Next Gen Stats (NGS) CSV files
2. Removed NGS data that occurred before the punt or after completion of the play
3. Identified all instances of contact between player and "contact partner"
   - Contact was defined as any time two players were located within a half-yard radius of each other at a fixed point in time
4. Joined player contact data with relevant game data
5. Merged the resulting dataset with data from video review of identifiable plays associated with concussions

You can view the code associated with this step here.

Step 2: Engineer Features

- Engineered the following features based on the data from Step 1
  - `dir_diff` = | cosine(player direction - contact partner direction) |
  - `high_temp` = whether or not the game temperature was above the median of all game temperatures
  - `hour_x` = hour of game start time, in 24-hour time notation
  - `late_week` = whether or not the game was played in the second half of the season
  - `middle_field` = whether or not the contact occurred in the middle 50% of field (i.e. away from the sidelines)
  - `o_diff` = | cosine(player orientation - contact partner orientation) |
  - `partner_diff` = | cosine(contact partner orientation - contact partner direction) |
  - `post_punt_duration` = time between punt and contact of players
  - `post_punt_playduration` = time between punt and completion of play
  - `self_diff` = | cosine(player orientation - player direction) |

Step 3: Classification

1. Incorporated the features engineered in Step 2 into the resulting dataset from Step 1
2. Cleaned data and removed unnecessary variables
3. Encoded categorical features as dummy variables
4. Normalized the data from 0 to 1
5. Fit a logistic regression model to the data
6. Calculated the model error
7. Interpreted the coefficients (i.e. results) of the model

You can view the code associated with this step here.

Results: Notable Coefficients

Variable	Description	Coefficient
late_week	game played during second half of season	1.74
post_punt_duration	time between punt and player contact	1.24
high_temp	game temperature exceeded median temperature of all games	0.66
o_diff	| cosine(player orientation - contact partner orientation) |	-0.73
Sunday	game played on a Sunday	-0.87
middle_field	whether or not the contact occurred in the middle 50% of field (i.e. away from the sidelines)	-1.17

increasing likelihood of injury

decreasing likelihood of injury

Negatively Correlated Features

The three most negatively correlated variables (which decrease the likelihood of injury):

1. The contact occurring in the middle 50% of the field that does not border a sideline
2. The game being played on a Sunday
3. Difference between player orientations

Analysis of Negatively Correlated Features

- It is ideal to keep the punt return contact in the middle of the field.
  - Players running near sidelines are more likely to run in unnatural ways, which increases the risk of injury.
- It is ideal to keep games on Sundays.
  - When players are in a weekly rhythm with sufficient rest, they are less likely to get injured.
- It is also ideal for players to be oriented in either the same or completely opposite (head-on) directions of each other.
  - Blind side contact plays (such as peel back blocks) are more likely to cause injuries than are face-to-face contact plays.

Positively Correlated Features

The three most positively correlated variables (which increase the likelihood of injury):
1. The game being played in the second half of the season (i.e. weeks 9 through 16)
2. Time between the punt and player contact
3. The game being played in high temperature

Analysis of Positively Correlated Features

- Games played early in the season are less likely to result in injuries than are games played in the second half of the season.
  - Players are more banged up and thus more likely to get injured when playing later in the season.
- It is ideal to limit the time that elapses between the punt and player contact.
  - An increase in this time interval results in players running at faster velocities, which yields increased injury risk. Also, plays break down and become less organized which causes unusual and unexpected contact.
- Games played in high temperature environments are more likely to produce injuries.
  - Dehydration and fatigue potentially reduce the ability of players to protect their bodies.

Current NFL Solutions Address Most Risk Factors

Negatively Correlated Features

- There is no effective way to encourage punt returns in the middle of the field as punts can fly in nearly any direction. Limiting movement of the returner would be nearly impossible.

- Current rules prohibit blindside blocks and blindside contact, and the NFL fines players who engage in such behavior. Besides increasing the fine amounts, there is not much more the NFL can do to prevent blindside contact between players while still maintaining integrity of the game.

- Most games are already played on Sundays, and from both a business and entertainment perspective, it would not be ideal for the NFL to remove prime-time games.

Current NFL Solutions Address Most Risk Factors

Positively Correlated Features

- The regular NFL season length is 16 weeks, and it is natural to assume that more injuries will always occur as the season progresses.
- The intuitive approach to addressing this risk factor would be to shorten the NFL season, but this is not ideal.
- Additionally, high temperatures are unavoidable at outdoor venues in areas such as California and Florida.

Solution

As we can see, many of the correlated features found in the analysis are already being sufficiently addressed, or cannot be further controlled without drastic changes to the game.

There is one notable exception: *the average duration of time between the punt and player contact can be controlled!*

If the average duration of a punt play can be reduced, the risk of injury in such a play will also be greatly reduced.

Punt plays can end in a wide variety of ways, but an easy way to guarantee a short punt play duration is a fair catch by the punt returner.

Rule Proposal: Move the ball 10 yards in advance of the spot of a fair catch to encourage returners to do so when there is not much open space for a return.

Evidence - NFL Punt Returns in 2018

Average return yardage for punt returns in the current season: **8.5 yards** (per [ESPN](#))

Since the proposed fair catch advancement of **10 yards** is greater than the average return yardage, punt returners are incentivized to make more fair catches *on average*.

Moreover, a 10-yard advancement will not disincentivize the punt returner's decision to return the football if he feels that a lengthy return is likely.

Thus, this rule change still allows for exciting, long punt returns to occur.

At the same time, situations in which there is increased likelihood of injury are limited, because these situations arise when there is only marginal benefit to be gained by returning the football.

With this rule change, integrity of the game is maintained.

Evidence - New College Football Kickoff Rule

NCAA College Football deployed a new kickoff rule this year that "gives the receiving team possession at its 25-yard line if a fair catch is made anywhere between the goal line and 25."

"...of the 9,079 kickoffs in the regular season, 41.2 percent (3,740) were returned. That's down from 51.2 percent at this point last season." - NCAA.com

Since this rule change incentivized NCAA teams to make more fair catches on kickoffs, it is safe to assume that the suggested rule change for advancement on a fair catch would also be an incentive in the NFL.

Coaches are often willing to sacrifice the opportunity of a big play for guaranteed advantageous field position.

Conclusion

We believe that allowing a 10-yard advancement after a fair catch will decrease injuries without significantly altering integrity and entertainment value of the game.

Players will still have the opportunity to attempt long punt returns, but will be encouraged to call for a fair catch if they expect only an average return.

Ultimately, the data shows that this rule change will lower the risk of injuries during punts. Moreover, since it does not eliminate the option for a player to return the punt it will allow for exciting returns to remain a part of the game.

Additionally, implementation of the rule will not be difficult as referees stop play anyway after a fair catch. The only additional action required by them is to advance the ball 10 yards.

Any Questions?

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