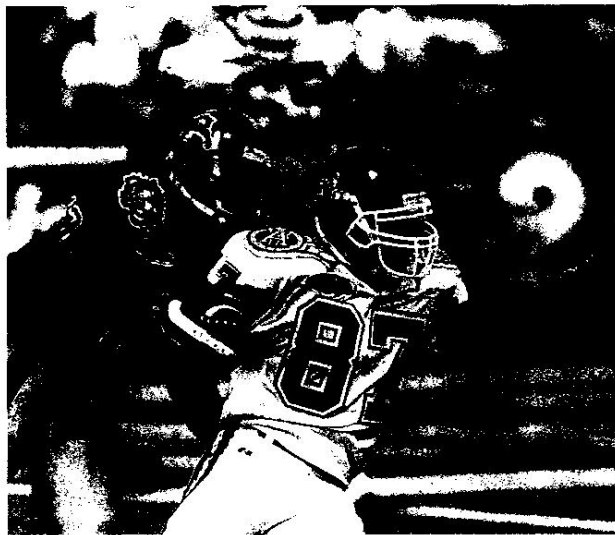

Determining optimal strategy requires finding the point value of field position.

The Return of a Missed Field Goal in Canadian Football

Keith A. Willoughby

Late in the first quarter of the 1987 Grey Cup, the championship game of the Canadian Football League (CFL), Toronto Argonauts' kicker Lance Chomyc attempted a 46-yard field goal. His kick went wide right. Edmonton Eskimo Henry "Gizmo" Williams caught the ball five yards deep in the end zone. He began to return the ball upfield, evading Toronto linebacker Don Moen then obtaining a key block from teammate Steve Benjamin. Williams finally stopped in the Argonauts' end zone with a 115-yard (that's right, 115-yard!) touchdown return. His spectacular effort was Edmonton's first touchdown of the game; they went on to earn a 38-36 victory over the Argonauts.

The return of the missed field goal is an important strategic decision encountered in Canadian football. Since the latter stages of the 19th century, professional teams have played a brand of football unique to Canada. In many vital aspects, this sport differs from the (more well-known) version of football played in the United States. Canadian teams have 12 players on the field at a time, while American football features squads of 11. Canadian teams are allowed three



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downs to advance the ball 10 yards. Four downs are used in American football. The respective fields are of different dimensions. Canadian football is played on surfaces 110 yards long (plus end

zones 20 yards deep), while American football uses 100 yard fields (with end zones 10 yards in length). Figures 1 and 2 illustrate the dimensions of the football fields.

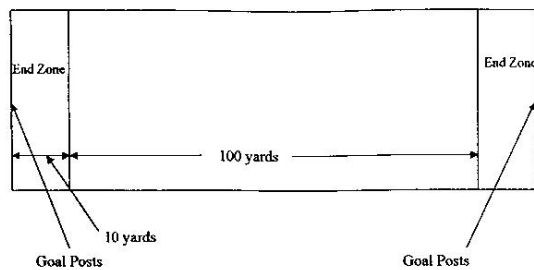


Figure 1. American football field – dimensions.

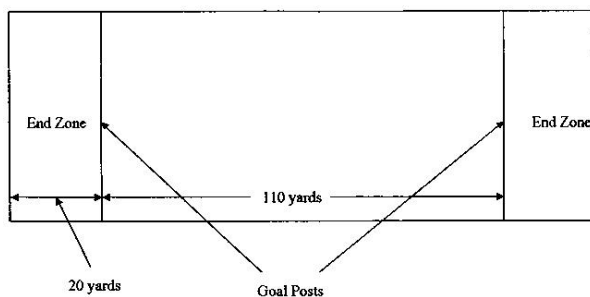


Figure 2. Canadian football field – dimensions.

The Missed Field Goal in Canadian Football

Perhaps the most striking difference between the two brands of football occurs when a team attempts a field goal. This play involves one team member attempting to kick the ball between two goalposts. A field-goal attempt is ruled unsuccessful when the ball fails to pass between the goalposts. In American football, the goalposts are positioned at the back of the 10-yard end zones (refer to Fig. 1). Consequently, when a field-goal attempt is unsuccessful, the ball usually travels out of play (beyond the boundary of the end zone). The referee blows his whistle and play is stopped.

In Canadian football, a missed field-goal attempt sets in motion a crucial decision. Inasmuch as the goalposts are positioned at the *front* (not back) of the end zone, and since the end zones are 20 yards deep, the ball may still be in

the field of play after an unsuccessful field-goal attempt (refer to Fig. 2). For this reason, Team A will position one player (e.g., Edmonton's "Gizmo" Williams in the aforementioned 1987 Grey Cup) in the end zone behind the goalposts. In the event that team B misses the field goal, Team A's player must decide whether or not to run the ball out of the end zone. Doing so is referred to as "returning the ball."

Returning the football out of the end zone, or failing to do so, has some scoring and strategic implications. When the player on Team A decides to return the missed field goal out of the end zone, Team A will initiate possession of the football at the yard line on which its player is eventually tackled. Obviously, it is to Team A's benefit to return the unsuccessful field goal as far up the field as possible. Returning the ball to only, say, Team A's one- or two-yard line would not be advantageous. Team A would then suffer from poor field position. It

would be forced to move the ball a great distance before reaching Team B's end zone. However, returning the ball a substantial distance up the field would represent a beneficial outcome for Team A. It would then have better field position, closer to Team B's end zone. Touchdowns resulting from the return of unsuccessful field goals represent Team A's best possible outcome for this decision.

However, Team A's player may decide it is not worthwhile to return the missed field goal. Such an action is called "conceding." The usual procedure involved in conceding is for the player, on retrieving the ball, to simply go down on one knee. This results in a stoppage of play. Team B receives one point for this unsuccessful field goal. Team A then begins possession of the football at either of the two following places (whichever is further from Team A's end zone):

- their own 35-yard line
- the yard line at which Team B had possession of the football before attempting the field goal

To clarify, suppose Team B had possession at Team A's 20-yard line. If Team B missed the field goal and Team A conceded a single point, Team A would begin possession of the ball at their own 35-yard line (the 35-yard line is further from Team A's end zone than the 20-yard line). However, if Team B was at Team A's 40-yard line before unsuccessfully kicking the field goal (and a single point was conceded), Team A would start a drive from their own 40-yard line (the 40-yard line is further from Team A's end zone than the 35-yard line).

For the sake of completeness, we ought to address the event of Team A deciding to return the missed field goal but the player being subsequently tackled within Team A's end zone. In other words, Team A's player did not make it out of his own end zone. This situation is viewed identically to the "conceding" case. Team B obtains a single point, and Team A begins possession of the football at either its own 35 or the point of last possession by Team B (again, whichever is further from Team A's end zone).

A missed field goal is by no means a rare occurrence in Canadian football. For example, during the 1998 CFL season a total of 424 field goals were attempted. Of these attempts, 306



resulted in successful field goals (a success rate of 72.2%). A total of 55 of the 118 unsuccessful field goals were returned out of the end zone, with the other 63 being conceded. (Data are from the CFL Web site www.cfl.ca.)

The Decision

Some key factors affect the return/concede decision. The current score differential in the game is likely to have an effect on the decision to return the missed field goal. For example, if the score was tied (particularly late in the game), then Team A would most likely return the ball. Conceding a single point in this case would give the lead to Team B. Further, if Team A held a one-point advantage in the final few seconds of a game, it would surely decide to return the missed field goal. Getting the ball out of the end zone would result in victory for Team A. However, consider a scenario in which the current score and time remaining in the game are of marginal consequence. (For example, the concede/return decision could occur during the initial stages of the game). Then, the decision is left largely up to the player preparing to return the missed field goal. Essentially, the concede/return decision becomes one of *points versus field position*. Conceding gives the opposition a single point but provides a team with possession of the

football at its own 35-yard line (or beyond). Returning the unsuccessful field goal saves Team A one point. However, it could begin a drive with relatively poor field position (if the player on Team A were only able to return the ball a short distance beyond his end zone).

The crucial issue, then, becomes one of determining at what yard line a team is indifferent between returning the ball or conceding a single point. In other words, how far up the field does the player on Team A need to get? Getting to his own one yard line does not seem like a good outcome. However, returning the ball out to, say, midfield would offer tremendous advantages. Team A saves one point *and* obtains great field position.

The Value of Field Position

The literature on the quantitative value of field position in professional football is sparse. Former quarterback Virgil Carter and operations researcher Robert Machol examined 56 games during the initial seven weeks of the 1971 National Football League (NFL) season. Their goal was to determine the expected value (in terms of points scored) of beginning a drive at various yard lines on the field of play. As one might expect, starting a drive at a yard line closer to the opponent's end zone had a larger expected point value than initiating possession of the football near one's own end zone. Beginning a drive relatively close to the opponent's end zone ensures that a team will stand a reasonably good chance of scoring, say, a field goal, even if they can only move the football a short distance.

To determine how far up the field a particular team needs to return the ball, we will follow, to a certain extent, the approach of Carter and Machol.

Specifically we develop a linear model, relating the field position at the start of the drive to the ultimate outcome of the drive. The field position refers to the distance from Team A's end zone at which the drive began. For example, a value of 3 for the explanatory variable (starting field position) would mean that Team A initiated possession of the football at its own three yard line – very

poor field position, indeed! If the value of the explanatory variable were 55, then Team A began a drive at midfield (recall that Canadian football fields feature a distance of 110 yards between end zones). We point out that, if the explanatory variable's value was 80, then Team A started its drive from Team B's 30 yard line.

Initially, it is useful to think of the response variable as being the score (if any) obtained by Team A during a particular drive. Generally, there are three potential scoring opportunities when a team has possession of the football – a touchdown (usually worth seven points), a field goal (three points), or a single point from a missed field goal. However, we also wanted to include the effect of Team A *not* scoring on a drive and subsequently turning possession of the ball over to Team B. Thus, we need to offer an important clarification to our definition of the response variable:

- If Team A scores on a drive, then the value of the response variable is simply Team A's particular score (seven points, three points, or one point).
- If Team A *does not* score on a drive, then the value of the response variable is the score obtained by Team B on its subsequent drive. These possible scores would be seven points, three points, one point, or zero points (the last case resulting if Team B failed to score during its possession of the football).



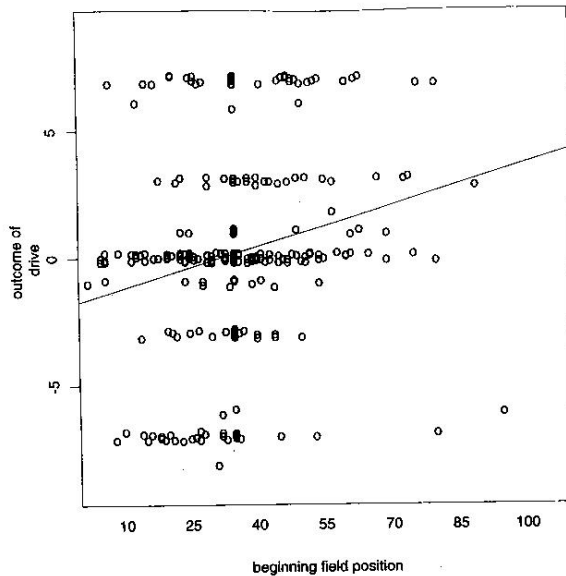


Figure 3. Scatterplot showing relationship between the outcome of a drive (as defined in the text) and starting field position. Points have been jittered in the vertical direction to display overlapping points by adding a small random deviation. The best fitting regression line is also shown.

For example, suppose Team A began a drive on its 40-yard line and eventually kicked a field goal. The resulting (explanatory variable, response variable) pair would be (40, 3). Suppose Team A initiated possession of the football at its own five-yard line and was unable to score on this drive. Suppose further that Team B scored a touchdown on its subsequent drive. Then, the resulting pair would be (5, -7). The negative number is used for the value of the response variable since Team B, not Team A, scored the touchdown. As a final example, assume Team A started a drive at Team B's 50-yard line and was unable to score on this drive. If Team B also failed to score on its subsequent drive, then the resulting pair would be (60, 0).

Why do we modify our definition of the response variable? Quite simply, we want to explicitly consider the dangerous effect of poor field position. If Team A begins a drive deep in its own end and fails to move the ball far up the field (or, even worse, fumbles the ball to the

opposition), the likelihood is fairly high that Team B will obtain possession of the football with great field position. Team B then stands a reasonably good chance of scoring (seven points, three points, or one point) on this drive. Generally, it is not advantageous for Team A to begin possession of the football with poor field position. In the event that Team A scored, we do *not* consider Team B's subsequent possession of the football. After Team A scores, it initiates a kick-off to Team B. In this case, Team B's starting field position is independent of where Team A began its scoring drive. Carter and Machol had a slightly different method for accounting for the effect of bad field position. They tried to account for *all* possible outcomes. Thus the outcome was either a score (seven or three) or turning the ball over to the opponent at the X yard line. This led them to a system of equations that could be used to find the value of different field position. We did not have enough data to carry out that analysis.

Results

The data for fitting our linear model were obtained from the Saskatchewan Roughriders, a CFL franchise. We used each of their games during the 18-game 1998 regular season. In all, we examined 272 drives, with 80 of these (29.4%) resulting in scores. For each of these drives, we recorded the beginning field position, the points scored by the Roughriders, and the points scored by the opposition (if the Roughriders failed to score any points on their drive). As an aside, we note that the minimum value for the explanatory variable was 2 (meaning that the Roughriders began a possession at their own two-yard line), while the maximum value was 95 (the Roughriders were able to start a drive at the opposition's 15-yard line). The average starting position was about the 36-yard line. The data are shown in Fig. 3. We fit a line to these data and obtained the following results: Expected points scored = $-1.738 + .054$ (field position). The slope coefficient gives the increase in expected points scored per yard of field position.

There are some key insights that can be obtained from this linear regression equation. Initiating possession of the football deep in one's end is indeed dangerous! For example, if the explanatory variable is 5, then the expected value of points scored is

$$-1.738 + .054 (5) = -1.468.$$

Starting a drive near one's own end zone and not being able to move the ball very far up the field could provide the opposition with excellent field position. The opposition then stands an exceptional chance of scoring on their subsequent drive.

For the CFL franchise currently under study, beginning a drive close to the opposition's goal line does not necessarily result in a touchdown (seven points). For instance, if the field position is equal to 94 (Team A is starting a drive on Team B's 16-yard line), then the expected value of points scored is $-1.738 + .054 (94) = 3.338$. Team A expects to score *some* points, but it may not *always* be a touchdown. This last result seems low, the result might be different for a team with more offensive success. It is noteworthy that the slope

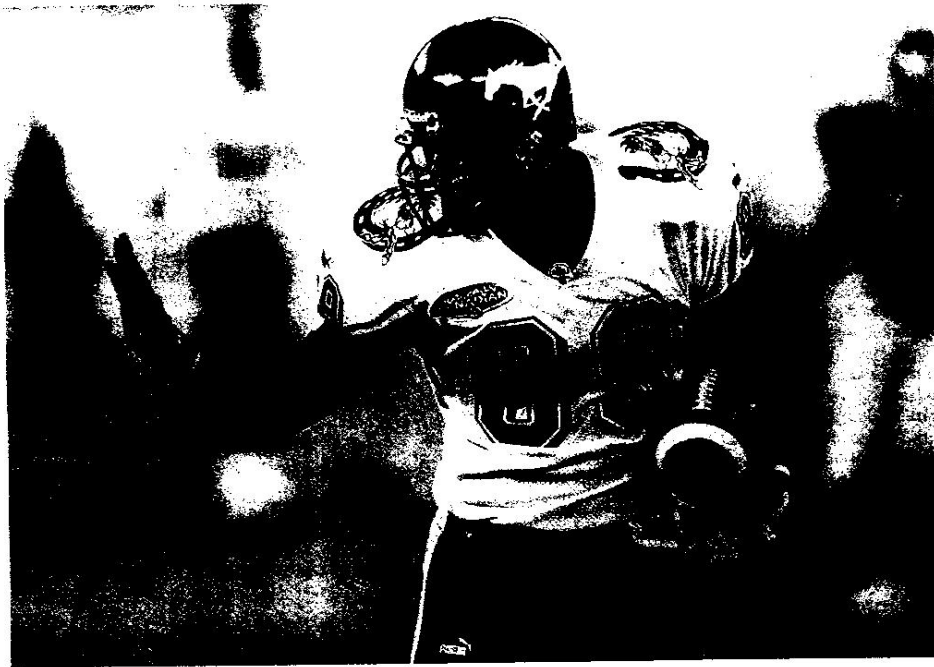


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here agrees reasonably well with the Carter and Machol result. They found a slope of .07.

Making the Decision

Recall that the return/concede decision involves points versus field position. Teams that concede give up a single point, but gain some valuable field position. Teams that return the missed field goal save the point, but may not end up with reasonably good field position. The value of the slope coefficient in our linear regression equation suggests that each additional yard of field position is "worth" .054 points (for this particular team). As a result, this team would equate about 18.52 yards with *one point* (let's round this up to 19, since football teams deal with yardage in discrete amounts). Thus, 19 yards of field position and a single point have roughly the same value. In other words, this team would be indifferent between giving up one point and gaining 19 yards of field position.

Consider first the case in which Team B attempts a field goal from at or within Team A's 35-yard line. If Team A concedes the single point, then it will obtain possession of the football at their own 35-yard line. Since Team A is indifferent between losing one point and gaining 19 yards of field position, it will only be attractive to return the football if the player on Team A is confident that he can get out to *at least* the $35 - 19 = 16$ yard line.

The appropriate decision is different if Team B attempts a field goal from beyond Team A's 35-yard line. Now if Team A concedes the single point, then it will start a drive from where Team B had possession of the football. We shall use the symbol N to refer to the yard line of Team B's possession before attempting the field goal (obviously, $N > 35$). Again, since Team A is indifferent between losing one point and gaining 19 yards of field position, the player on team A ought to return the football only if he is confident that he can get out to *at least* the $(N - 19)$ -yard line. Being unable to return the ball that far means that

they have sacrificed too much field position, even though they did not give up one point.

In the 1987 Grey Cup story that started this article, N was 39. The decision rule obtained by our statistical analysis suggests that the returner needed to be confident that he could get to the 20-yard line. Apparently he was confident and correct.

[Without implicating them, we wish to thank the following employees of the Saskatchewan Roughriders for their valuable assistance in this project: Mr. Cal Murphy (Former Head Football Coach) and Ms. Tennille Grimeau (Marketing and Sales Assistant)].

References and Further Reading

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