

BY TIM DOUGHERTY

# WHAT THO'

## Rethinking 4th-down Risk

Mathematical models offer football coaches a radical way to optimize offensive production

$$P_{gt} = \sum_i D_{gt}^i V_i - B_{gt} \sum_i D_{gt+1}^i V_{i+}$$

FOOTBALL IS AN ABUSIVE MARRIAGE OF UNRESTRAINED RAGE AND SHREWD STRATEGY.

From sideline to sideline, it's a life insurer's nightmare: a cacophony of bone-crunching collisions that have been initiated by people named "Mean" Joe Greene, "The Assassin" Jack Tatum, and "The Molester" Lester Hayes.

Take a step beyond the chalk, however, and it's a different world, one that more closely resembles a chess match: emotionless coaches measuring risk and directing their players to execute plays that are carefully calculated to achieve optimal results—victory.

A football coach's stoic display of indifference to the volatile tides of popular opinion is no more evident than when, after three unsuccessful attempts by the offense, a first-quarter drive has stalled and the ball rests 2 yards short of the end zone. As the pigskin sits on a bed of bluegrass with a front-row ticket to the promised land, the hometown crowd tries to will it home, sending chants of "Go for It!" reverberating throughout the stadium and urging their fearless leader—to put it bluntly—to be a man.

# THE ODDS



$$e_{gt} = \sum_i V_i (D_{gt}^i - B_{gt} D_{gt+1}^i) + e_{gt}$$

But the coach is the one who gets paid to make the decisions. He's the one with the years of experience dealing with these situations, and he, therefore, makes a rational assessment. With only 2 yards to go, he's tempted to go for it, but he knows there's a good chance he will fail. (If he's done a little homework, he might know his odds of success are around 43 percent.) After a long offensive drive, he doesn't want to come away empty-handed, and a field goal is a virtual certainty from that distance. With over three quarters to play, he sends in the kicker and takes the guaranteed points over a shot in the dark. He resists the urge to take a chance; instead, he plays it safe and "goes by the numbers."

Except, well, he really hasn't. Sure, he'll point to the 43 percent chance of success, but it's doubtful he really knows how to put that into any wider context. He's operating on a crude best-guess strategy in the absence of more complex historical data. The decision seems easy because he hasn't performed any stochastic modeling that could develop the most efficient risk management strategies.

But there are those who have. David Romer is one of them. And according to Romer, an economics professor at the University of California, Berkeley, by going for the small, guaranteed gain over the larger, riskier touchdown, the team's rational and clearheaded coach just *decreased* his chances of winning the game by 3 percent.

Romer's football investment advice is contained in a research paper, "Do Firms Maximize? Evidence From Professional Football," that was published in the April 2006 issue of the *Journal of Political Economy*. After listening to Oakland Raiders radio announcers applaud a decision to kick a field goal in a situation much like the one described above, the economist in Romer couldn't help but question the institutional presumption that it's more valuable to kick.

"It's an idea that wouldn't go away," Romer explains. "It didn't seem obvious to me that you should take the three points."

On a hunch that football coaches play it too conservatively in fourth-down situations, Romer decided to get proof. Perusing the first-quarter play-by-play records of 732 National Football League (NFL) regular season games between 1998 and 2000 (the records of four games weren't available), he performed dynamic programming analysis to measure the difference in expected value between going for it on fourth down and kicking the ball (either a field goal or a punt) from various points on the field.

According to Romer's analysis, the net value of a decision to go for it or to kick is the sum of two separate values: the immediate

## Measuring the complete value of a decision to go for it or kick in a given situation requires taking into account ensuing field positions for unsuccessful touchdown tries as well as successful touchdowns and field goals.

payoff in points scored plus the value in having a first down at a given point on the football field based on expected future scoring. The first part is straightforward. A touchdown is worth six points, an extra point worth one, a field goal worth three. In the case of a fourth-and-goal from the 2-yard line, a field goal is virtually guaranteed (as is an extra point, in which the ball starts at the 2-yard line in the NFL). Therefore, the team would need to expect a success rate of 43 percent (three-sevenths) when going for the touchdown in order for the immediate payoffs of the decisions to match each other. Anything under 43 percent, and a field goal has a higher payoff. Anything over that and a touchdown has the higher immediate payoff. Turns out, as mentioned earlier, teams are successful on average 43 percent of the time.

If that were all there was to it, teams should be indifferent toward kicking or going for the touchdown. But, as fans can be quick to point out, if a team fails in its attempt to score a touchdown, it'll pin the opposing offense inside the 5-yard line. And that has to be worth something.

But how much, exactly?

### Mapping the Gridiron

That's where Romer comes in. In his study, he focused on 101 different situations—first down and 10 on each yard line from a team's 1 to the opponent's 10, a first and goal on each yard line from the opponent's 9 to its 1, a kickoff from the team's 30 (following a field goal or touchdown, or at the beginning of a half), and a kickoff from its 20 (following a safety). He performed dynamic programming analysis using the data of 11,112 first-quarter plays to assign an expected value of a given situation based on the likelihood that situation will result in scoring before the opponent scores. (Since Romer's data consisted entirely of first-quarter plays, the data should be reliably risk neutral and independent of game situations because the play calling is unlikely to be influenced by the score of the game and time remaining.)

Much of his research on field-position value advanced ideas first presented in a 1971 paper by Virgil Carter, a former Cincinnati Bengals quarterback, and Robert Machol, a former systems engineer, professor at Northwestern's Kellogg Graduate School of Management, and chief scientist for the Federal Aviation Administration. The pioneering paper, "Operations Research on Football," established a purely linear relationship between field position on first and 10 and expected points. According to their

work, expected value ( $V$ ) is a function of field position ( $x$ ) such that  $V = 5.91 + 0.077x$ . To determine the expected value of a decision to go for it, Carter and Machol took into account the probability ( $p$ ) of successfully gaining a first down.

$$V_{go} = p[5.91 + 0.077x] - (1-p)[5.91 + 0.077x]$$

Romer followed a similar process in his study, analyzing each situation to determine an expected value for each position based on the likelihood a team will score in that scenario. Even with a sizable data sample, Romer (like Carter and Machol) smoothed his results to eliminate variance and develop a precise function of value based on the team's position on the field. This enabled him to incorporate his data into what is known in economics as a Bellman equation, allowing him to perform a recursive analysis to establish predictable conditions that a team can apply in in-game strategy to optimize the number of points it scores and, by extension, its chance of winning.

"If this is correct," Romer writes, "forcing the estimates of the [value] to be smooth will improve the precision of the estimates while introducing minimal bias. I therefore require the estimated [values] for first down to be a quadratic spline as a function of the team's position on the field."

Romer broke the field into knot points at the 9-, 17-, and 33-yard lines and at the 50. Counting kickoffs and free kicks received and kicked, the spline reduced the parameters from 101 to a more manageable 12, allowing Romer to smooth the results and assign an expected value ( $V$ ) for having the ball in each of the 101 situations.

Unlike Carter and Machol's studies, Romer's research indicated that the relationship was linear in parts, but the value increased (or decreased) more sharply as a team approached either goal line, as well as when it approached the opponent's 35-yard line. (He credits this difference to the greater wealth of data online, compared to the cruder data available in the 1970s.)

At one extreme, for a first and 10 on one's own 1-yard line,  $V$  equals -1.6. At a team's own 15-yard line,  $V$  equals zero, meaning the team would be indifferent toward having the ball at its own 15 and its opponent having the ball at the opposite 15. From a team's own 15-yard line, the value of  $V$  increases at a relatively linear rate of one point roughly every 18 yards until reaching the opponent's 15, where the value is close to 3.88. Then  $V$  again increases rapidly until at the other extreme, for a first and 10 at the opponent's 1,  $V$  equals 5.55.

<sup>W</sup> Another key number is 0.6, the value of having the ball at one's own 27-yard line. Since a kickoff will, on average, give the opponent the ball at its 27-yard line, the value of a kickoff for the kicking team is -0.6. (According to the study, the Vs are relatively precise with a standard error of less than 0.1.)

Measuring the complete value of a decision to go for it or kick in a given situation requires taking into account ensuing field positions for unsuccessful touchdown tries as well as successful touchdowns and field goals. Therefore, with the ball on the 2-yard line, the estimated value of a field goal is 3 (value of payoff) minus 0.6 (expected field position value), or 2.4. On the other hand, in that same situation when Romer factors in the payoff of a touchdown (taking into account the likelihood of success) plus the value of field position for both successful and unsuccessful touchdown tries, the estimated value of going for the touchdown equates to approximately 3.7 points—or 1.3 more expected points per situation than kicking a field goal. According to Romer, the value of going for it outweighs the value of kicking as long as a team expects to convert as rarely as 18 percent of the time.

"Since each additional point raises the probability of winning by about 2.3 percentage points," Romer argues, "trying for a

touchdown on average increases the team's chances of winning the game by about 3 percentage points each time."

However, in Romer's sample, every single time a team faced fourth down from the 2, it elected to kick a field goal.

### Aggression Pays

Though the above situation is one easily identifiable example of potential inefficiency in NFL fourth-down risk management strategy, the same principles can be applied to fourth-down situations all over the field. According to Romer, when a team has the ball on its own half of the field, "going for it is better on average as long as there are less than about 4 yards to go." Once a team crosses midfield, it pays to be more aggressive, and the cutoff increases to 6.5 yards at the opponent's 45-yard line. This is mostly due to the fact that the net yardage of a punt decreases because the punter has less room to work with. (In order to gauge the probability of converting a fourth down from given distances, Romer had to use more than just fourth-down stats, which were limited considering that teams rarely go for it. To have a statistically significant sample size, he compiled the average gains of third-down plays from that same distance. Since teams currently approach third down as a

## EMBRACING RISK AS A FORMULA FOR SUCCESS

**WHILE FOOTBALL COACHES AT THE HIGHEST LEVELS have dismissed the aid of academic research, there's a high school coach in Arkansas who's been much more receptive.**

Kevin Kelley, head football coach at Pulaski Academy in Little Rock, has developed a shrewd way to avoid making difficult fourth-down decisions. He just doesn't punt. Ever.

Well, actually he punted twice last year, but that's only because he felt bad for the other team, which couldn't seem to find a way to stop his Bruins offense in the waning moments of another victory.

Ever since Kelley saw a study (not Romer's, he says) on the statistical consequences of going for it on fourth down versus losing the ball on downs, Kelley wondered why anyone ever punts the ball.

Looking at the stats from every Division I college game in the past three years, he saw that if the other team's players acquire the ball inside the opponent's 40, they're going to score a touchdown 77 percent of the time. If they take over

inside the 9, they'll score 92 percent of the time.

"If you're on your own 5-yard line on fourth and 10, if you punt, you'll net about 25 yards, maybe 30," Kelley explains. "If you give them the ball on the 35, they're probably going to score a touchdown anyway. Give it to them on your own 5, it's only a 15 percent difference in odds."

The way Kelley sees it, why choose an option that gives you only a 15 percent better chance of keeping the other team from scoring a touchdown, when you have about a 50 percent chance (based on Pulaski's 199 fourth-down attempts in the past five years) of getting a first down and keeping your opponent off the field entirely.

"It's not a gimmick," Kelley says. "We don't do stuff just because it's been done that way. I actually believe statistically it gives my team the best chance to win a football game."

Like the 2006 state semifinal, for instance, in which his Bruins faced fourth and 5 from the team's own 5-yard line. They went for it, got the first down, and won a 43-42 thriller to vault them into the state finals.

That was Pulaski's second trip to the finals (including one state championship) since Kelley took over in 2003, a major reason that he's been able to convince others of his way of thinking. After convincing his players, coaches, and school administration—which, he admits, was a slow process—he is slowly building a culture that questions football's status quo of risk aversion from the peewee ranks on up.



Kevin Kelley calling in a play from the sidelines.

PHOTO COURTESY OF CHARLES CLOGSTON

**If you think about being a rational decision-maker, you'd think a coach would want to maximize the probability his team wins eventually. What he's probably trying to do is minimize the chance that his team loses the game immediately.**

do-or-die situation, the playcalling and results should be reliably consistent with how fourth-down attempts would result if teams went for it more often.)

At the opponent's 33, the offense reaches a no man's land, where a field goal is too long to be depended on and a punt can easily sail into the end zone for a touchback (bringing the ball all the way back to the 20). At the 33, the distance at which it is still more advantageous to try for a first down peaks at 9.8 yards. Once the team faces more manageable field goal distances, the number bottoms out at 4.0 at the 21-yard line. Inside the red zone, however, the odds of making a field goal do not rise as much as the value of going for it, and once the team advances to the 5, it's better on average to go for it.

It won't come as a surprise for any of those vocal hometown fans to learn that these findings again differ drastically from the actual in-game choices. Of the 1,068 fourth-down situations in which Romer's analysis suggested teams were better off going for it, they chose to kick 959 times, or about 90 percent. To put it another way, those NFL coaches who have spent hours studying film to create week-by-week schemes tailored to their opponents and who then stand on the sidelines bedecked in earmuff-sized headphones with faces hidden behind play charts to isolate themselves from the corrupting decision-making influence of emotion, well, they may not be as shrewd as they let on. They may actually be squandering valuable chances to score points and, by extension, to win football games.

Gregg Easterbrook, senior editor of *The New Republic*, fellow at the Brookings Institution, and a regular columnist for ESPN.com during the NFL season, had Romer's formula tested in computer simulations by the sports analysis firm AccuScore (one of the most accurate game-prediction sources for fantasy sports enthusiasts and recreational wagers). When pitting two evenly matched teams against each other over 10,000 sets of simulations, one using Romer's formula and the other using NFL norms, the more aggressive style netted one more point scored per game and became 5 percent more likely to win (i.e., the team would win one more game for every 20 it played).

### **Entrenched Resistance**

Baseball has undergone a paradigm shift over the past decade in the use of statistical analysis, pioneered by Billy Beane, the general manager of the Oakland Athletics, who started utilizing the research of statistician Bill James. By the time author Michael Lewis wrote *Moneyball*, a 2003 bestseller that broadcast Beane's strategy

to the world, the wheels of a revolution were already rotating (see "Stat of the Art," May/June 2004 *Contingencies*, [www.contingencies.org/may/jun04.stat.pdf](http://www.contingencies.org/may/jun04.stat.pdf)).

So far, however, football has been resistant to new ideas that challenge its heuristic methods with highly researched data. And Romer isn't the only one doing this kind of research.

David Annis, director of quantitative analysis in the internal auditing division at Wachovia, recalls getting into many sports argument with his friends before he realized that these types of debates can be settled with numbers. He did, after all, have a doctor-

## **PIGSKIN PIONEERS OF**

**FOOTBALL HASN'T ALWAYS BEEN SO TIMID to challenge the ways it views risk. As an end at Notre Dame in 1913, Knute Rockne and quarterback Gus Dorais revolutionized the sport by unveiling the forward pass as a regular weapon of the Notre Dame offense en route to defeating national powerhouse Army 35-13.**

**In a sport that for decades to come revered the "3 yards and a cloud of dust" attitude toward offensive strategy, Notre Dame decided to accept the risks inherent in passing the ball (higher percentage of plays that gain zero yards via an incomplete pass, higher percentage of plays that result in big losses via sacks, greater likelihood of turning the ball over via interception) in exchange for its rewards (more yards per play, greater likelihood of breaking big plays). The 1913 Army game is credited as a turning point in offensive strategy.**

**While the passing game became more popular over the years, for the better part of the 20th century, it was still viewed as a secondary mode of attack. Teams first established the run in order to bring the defensive secondary up to defend it. That would set up the pass as teams began to take chances down the field.**

**Bill Walsh flipped this philosophy on its end when he took over the San Francisco 49ers in 1979. Walsh installed a system that relied on short, safe horizontal pass routes to control the clock. Although the routes required precise timing between the quarterback, receivers, tight ends, and running backs, they were mostly low-risk passes that advanced the ball up the field quicker than run plays.**

ate in mathematical statistics. Now, his website SportsQuant.com offers an abundance of evidence to make his case on everything from potential college football playoff systems to optimal endgame tactics in basketball and fourth-down football strategy. He has created a program in which you can enter specific information for a given situation (down, distance, possession, time remaining, score, timeouts remaining—even who kicked off first), and the program will simulate the rest of the game, automatically running the most likely play call based on documented tendencies.

Annis has looked at the research of Romer, Carter and Machol, and others, and, whatever the differences between them, he thinks they all support their predictive purpose.

"It's an interesting thing," he says. "There are a couple of different ways to work out the probabilities, and they all provide similar answers."

Answers that football coaches continue to lack interest in. It's not just that they aren't listening, but they are often rejecting the information with a ferocity that one would expect to see less from an otherwise imperturbable coach and more from, say, NFL Hall of Fame linebacker Dick Butkus during a league game.

In the winter of 2006, ESPN asked various NFL coaches their

reactions to Romer's studies. The verbal responses were dismissive, and—considering that in-game decisions continue to be as conservative as they've ever been—that attitude doesn't seem to have changed. Maybe the numbers indicate it might be better to go for it on average, they conceded, but what about the one time it backfires? What about the time the offense gets stuffed at its own 40-yard line and the other team takes that short field, scores a touchdown, and ends up winning a close game?

"If you think about being a rational decision-maker, you'd think a coach would want to maximize the probability his team wins eventually," Annis says. "What he's probably trying to do is minimize the chance that he loses the game immediately."

Gary Kubiak, then the rookie head coach for the Houston Texans, admitted as much when he told ESPN that coaches don't want to make an early gaffe that they could potentially be fighting to rectify for the rest of the game. A number of coaches shared that sentiment, including Al Saunders, then the offensive coordinator for the Washington Redskins who now runs the St. Louis Rams offense.

"Coaches would rather feel as though they subconsciously play not to lose,"

## THE PASS AND PRESENT

Walsh's offense more accurately used the short pass to set up longer passes, as well as setting up a running attack that would wear out the defense late in the game. Walsh placed this increased responsibility on the right arm of quarterback Joe Montana, who led the 49ers to four Super Bowls in the 1980s (the last after Walsh retired) and won an NFL record four Super Bowl Most Valuable Player awards. Today, almost every NFL team runs a derivation of what came to be known as the West Coast Offense.

As football has evolved, so have its ways of measuring a player's value. Former insurance actuary John Dewan, who served as president and chief executive officer of the sports statistics and information firm Sports Team Analysis and Tracking Systems (STATS) Inc. during the 1990s, says his firm was the first to systematically track the number of yards after catch (YAC) that receivers, tight ends, and running backs gained on passing plays. Though at first it seemed like a novelty, it's now a commonly used stat to measure a wide receiver's value and is especially relevant to measure receivers' value in a system like the West Coast Offense.

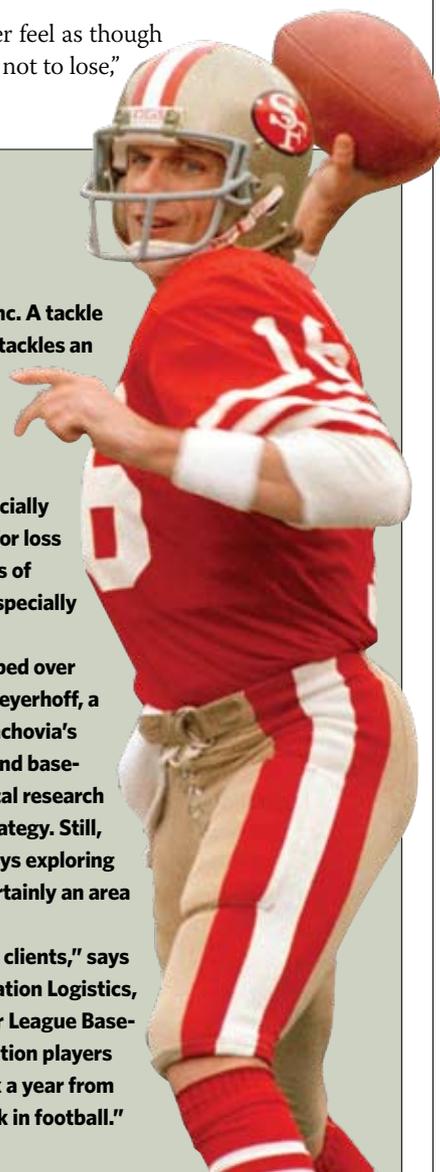
"There are more potential stats in football than in other sports [because] there are more types of players: stats specific to running backs, quarterbacks, cornerbacks, linebackers, offensive line, kickers," says Dewan, who currently owns Baseball Info Solutions.

"Stuffs," or tackles for loss, are another stat Dewan says

was created while he was at STATS Inc. A tackle for loss is recorded when a defender tackles an offensive ball carrier on a designed run behind the line of scrimmage. While quarterback sacks have received wide recognition since the 1970s—though the stats weren't officially kept by the NFL until 1982—tackles for loss have become another valuable means of measuring the value of a defender, especially defensive lineman.

While new statistics have developed over the years, Dewan and actuary Bob Meyerhoff, a partner at STATS Inc., agree with Wachovia's David Annis that football is well behind baseball in using higher-level mathematical research to influence macro approaches to strategy. Still, both actuaries say that they are always exploring new opportunities, and football is certainly an area that they monitor.

"We'd love to have some football clients," says Meyerhoff, now president of Information Logistics, where he works primarily with Major League Baseball and National Basketball Association players unions and sports agents. "If we talk a year from now, I could tell you we're doing work in football."



ERIC RISBERG / AP IMAGES

Saunders said. “They don’t want to do something out of the ordinary to lose. It’s easier to do what’s expected and safe.”

Generally speaking, football coaches operate in a culture of risk aversion. They are reluctant to accept an uncertain but higher payoff—even when the higher payoff already factors in likelihood of success—in favor of a lower but more certain payoff.

But what are they actually afraid of? Coaches like Kubiak say it’s losing a game. According to Romer, teams that follow the results of the Bellman equation would win a net of one more game every three years than they would’ve won by following the status quo. According to analysis done by AccuScore, more aggressive

play can net nearly one win a season. Though not earth-shattering, given the parity of the NFL, it could mean the difference between making the playoffs and spending January at home with a pink slip.

It also means that football clichés like “playing it safe” and “going by the numbers” are often inaccurate assessments of the situation, since a decision can’t be safe if it’s empirically less likely to lead to victory.

But a coach might be using a different metric to value safety. Even if he pulls more games out of his hat than he gives away, in the sound-bite and highlight world in which coaches operate,

## AFTER FURTHER REVIEW



### 1980 Holiday Bowl— Southern Methodist vs. Brigham Young

This game is usually remembered for its last play, a 41-yard touchdown heave by BYU quarterback Jim McMahon as time expired to cap a 20-point comeback in the final three minutes. Eight minutes earlier, however, BYU was down by 19 facing yet another fourth-and-long from midfield when head coach Lavelle Edwards sent the punt team in. The hot-headed quarterback refused to get off the field, forcing Edwards to call a timeout. When Edwards sent the offense back on the field, McMahon connected for a first down and marched the Cougars to the first of several late scores.

MARK PHILBRICK



### 1996 Big XII Conference Championship— Texas vs. Nebraska

Clinging to a three-point lead with 2:30 left in the game, Texas faced fourth-and-inches from its own 29-yard line. Quarterback James Brown faked a handoff to future NFL rushing leader Priest Holmes and rolled out to his left, where he found a wide-open tight end who wasn’t chased down until he reached Nebraska’s 11-yard line. The play set up a Texas touchdown as the Longhorns won 37-27, dashing undefeated Nebraska’s national championship hopes.

UNIVERSITY OF TEXAS SPORTS PHOTOGRAPHY



### 2006 Rose Bowl—Texas vs. USC

Almost a decade later, Texas was on the defensive end of the same situation with the national championship on the line. Up 38-33, Southern Cal had fourth-and-2 at the Texas 45-yard line with 2:13 left. USC coach Pete Carroll chose not to punt and tried to go for it and run out the clock. But the Longhorn defense stopped the play short, and quarterback Vince Young drove Texas down the field for the winning touchdown.

UNIVERSITY OF TEXAS SPORTS PHOTOGRAPHY

the sting of losing a game that can be directly attributed to a coaching decision can be more painful than the windfall of a win. Football coaches work in a media environment that has given the “riverboat gambler” label to coaches whose decisions are nearer the optimal curve—though still far below it. (In college football, that term is often applied to aggressive fourth-down coaches like Notre Dame’s Charlie Weis, Texas Tech’s Mike Leach, and Louisiana State’s Les Miles, but even those coaches don’t go for it nearly as often as the studies suggest they should.) Having a loss that can be pinpointed to a coaching decision may be riskier to a coach’s career prospects than being known as a coach who loses

more games because he plays to keep the game close, essentially allowing his players to shoulder the blame when they fail to make up the difference in potential points scored.

The attitudes of Kubiak and Saunders aren’t surprising considering that Kubiak has only recently climbed to the head coaching ranks and Saunders has yet to get there. Looking at data on fourth-down decisions from 1997 to 2006 assembled by Aaron Schatz and Jim Armstrong at [footballoutsiders.com](http://footballoutsiders.com), if there’s one correlation to being aggressive, it’s tenure. The most aggressive coaches in that time span (by percentage of times they went for it on fourth down versus the number of opportunities) reads like

MICHAEL AND SUSAN BENNETT, LIGHTHOUSE IMAGING



### 2005 USC vs. Notre Dame

With six minutes left in the first quarter on a fourth-down play from Notre Dame’s 29-yard line, quarterback Brady Quinn sneaked through the line for a first down, keeping alive a drive that ended in a Notre Dame touchdown. Southern Cal reciprocated in the third quarter when it faced fourth-and-1 from its own 19-yard line. After USC’s previous punt was returned for a touchdown, coach Pete Carroll decided to go for it. Matt Leinart converted on a quarterback keeper—a precursor to the more famous fourth-quarter play that won the game for the Trojans 34-31.

### 2006 Notre Dame vs. Georgia Tech

In their 2006 opener, the Fighting Irish led 14-10 with 1:10 left in the game at the Georgia Tech 47. Needing 1 yard to go, Weis sent quarterback Brady Quinn plunging through the line on fourth down to seal the game. Similarly, at the end of the first half with the Irish on the Yellow Jacket 5-yard line and time for one play, Weis eschewed a field goal and sent Quinn scrambling for Notre Dame’s first touchdown.



MICHAEL AND SUSAN BENNETT, LIGHTHOUSE IMAGING

### 2007 BCS Championship Game—Florida vs. Ohio State

Down 24-14 with under four minutes left in the first half, Ohio State tried to jump start its offense and rest its tired defense, which had



been on the field most of the game. On fourth-and-1 from its own 29, running back Chris Wells ran into a wall of Florida Gators for no gain. Florida kicked a field goal and another touchdown before halftime. Ohio State never recovered, as the Gators cruised to a 41-14 blowout victory to claim the national championship trophy.

### 2007 Florida vs. LSU

With six minutes left in the first half, LSU had the ball on the 1-yard line on fourth down. Trailing 10-0 to Florida, Tigers head coach Les Miles made the first of five maverick moves that night, sending quarterback Ryan Perrilloux into the end zone for the score. Still behind early in the fourth quarter, LSU scored another touchdown on fourth down from 4 yards out to cut the Florida lead to three points. With just a few minutes left, Miles decided to forgo a game-tying field goal from the 7-yard line, sending his running back through the line for a 1-yard gain to keep alive the winning touchdown drive. Final score: 28-24.



STEVE FRANZ, LSU

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a list of first-ballot Hall of Famers: Bill Parcells, Bill Belichick, Bill Cowher, Marty Schottenheimer, and Mike Shanahan. Among them, the group has won eight Super Bowls, and Schottenheimer, the only one without a ring, ranks sixth all time in wins (205). Whether they were successful because they were aggressive or they could afford to be aggressive because they have been successful may be up for debate.

However, looking at the list of least aggressive coaches, there is a direct correlation between fourth-down attitudes and perceived job security. Four of the top five least aggressive coaches on the list were rookie head coaches in 2006: Sean Payton, Kubiak, Rod Marinelli, and Scott Linehan. The other, Nick Saban, was a first-year NFL head coach in 2005 and has already bolted from the NFL to coach the University of Alabama.

### Forward Progress Stalled

Annis says football fans shouldn't anticipate seeing their teams give the boot to their punters anytime soon. In his estimation, football is years away from fully tapping into the potential research available to redefine the way the sport looks at risk.

"I've spoken with a couple of teams over the last three or four years," Annis says. "Even those that do express interest are not as far along or committed to new research as you might hope they'd be."

Romer's experience has been similar. The hard part, he thought, would be getting the attention of the coaches. Once enlightened, he thought, they wouldn't be able to ignore those numbers. He even admits that a small part of him fantasized about entertaining job offers to come up with organization strategies for various teams. (After all, Bill James is now a senior adviser for the Boston Red Sox.)

Turns out, virtually every NFL coach and many more college football coaches knew about Romer's work within months of its release. And his biggest challenge has been getting them to care.

"I think of it as 'How would an economist or an actuary think about this problem?' and we would immediately think about the risk and reward and probabilities. We'd look at the chances of success and chances of failure, how costly is failure and how beneficial is success," Romer says. "But most of a coach's job is motivating and training people, big-picture strategy things. Their whole way of approaching a problem is different than the way an economist or an actuary would." ●

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