The Brigham Young University Football Program and the Analytics Revolution

Nelson Chung

The Brigham Young University football program is the most visible component of the LDS Church's flagship school. In 2010, it contracted to ESPN the broadcast of a majority of its games for a reported $800,000 to $1.2 million per home game through 2018.[1] During the 2015 season, its eight games on the ESPN–ABC family of networks reached 14.8 million televisions, an average of 1.9 million each game.[2] In terms of missionary value, the program rivals the Mormon Tabernacle Choir. Along with publicity, the Choir has also invited a fair amount of scholarly attention, most notably a study of how its contract with Columbia Records led to a secularization of part of its repertoire,[3] a chapter in the University of Illinois Press's *Mormonism and Music* volume,[4] an entire volume of its history in the same publisher's *Music in America* series that

1. Ed Szczepanski, "Marriage between BYU and ESPN Still Going Strong," *Fox Sports,* May 19, 2015, http://www.foxsports.com/college-football/story/marriage-between-byu-and-espn-still-going-strong-051915.

2. "College Football TV Ratings," *Sports Media Watch,* http://www.sportsmediawatch.com/college-football-tv-ratings/.

3. Mark Porcaro, "We Have Something Really Going on Between Us Now: Columbia Records' Influence on the Repertoire of the Mormon Tabernacle Choir, 1949–92," *Choral Scholar* 1, no. 1 (2009): 41–115.

4. Michael D. Hicks, *Mormonism and Music: A History* (Urbana-Champaign: University of Illinois Press, 2003).

Nelson Chung

I have always been inspired by world leaders who believed scientific leadership to be critical to national competitiveness. And I became interested in BYU football when I was ten years old upon listening to Ty Detmer lead the Cougars to upset first-ranked Miami in 1990. That event was also the genesis of my aspirations to attend BYU, which I did during the era of Brandon Doman and Luke Staley, also when Erin Thorn elevated the women's basketball team to national prominence.

Through reading a spate of sports analytics works, I accumulated ideas for BYU football that became the impetus for this article. However, as the writing process unfolded, the article evolved into more a work of intellectual history, a contextualization of the BYU football program within the growth of analytics, and less an instruction manual. My main hope for this piece is that it will inspire other quantitatively adept yet passionate BYU fans to contribute their own work that will benefit the program. Let a thousand regressions bloom.

linked the Choir to Mormon theology on angelic music,[5] a review of that volume,[6] and accounts of its European and Pacific tours.[7]

In contrast, scholarship on BYU sports is scant. A search for peer-reviewed sources on lib.byu.edu yielded just three results. Current

5. Michael D. Hicks, *The Mormon Tabernacle Choir: A Biography* (Urbana-Champaign: University of Illinois Press, 2015), 35–61.

6. Jake Johnson, "*The Mormon Tabernacle Choir: A Biography,* by Michael Hicks," *Notes* 72, no. 3 (2016): 522–24.

7. Cynthia Doxey, "The Mormon Tabernacle Choir's European Tours," in *Regional Studies in Latter-day Saint Church History: Europe,* ed. Donald Q. Cannon and Brent L. Top (Provo, Utah: BYU Religious Studies Center, 2003), 185–99; Cynthia Doxey and Lloyd D. Newell, "The Mormon Tabernacle Choir's Pacific Tour, 1988," in *Regional Studies in Latter-day Saint Church History: The Pacific Isles,* ed. Reid L. Neilson and others (Provo, Utah: BYU Religious Studies Center, 2008), 127–92.

BYU president Kevin J. Worthen, when serving as advancement vice president, held BYU's successful lobbying of the National Collegiate Athletics Association (NCAA) to revoke waivers to their rules accommodating Sunday nonplay to be a case of how internal pressure can affect nongovernmental bodies.[8] The two other works treated past and residual racial issues surrounding the football program.[9] This article provides a new angle by examining BYU football in light of the proliferation of "analytics," or advanced statistics, in sports and finds that analytics illuminate the program's condition across time, predict its future, and have made their way into the program's decision-making process.[10]

The core of this article comprises two parts. In the first part, I demonstrate what the sports analytics revolution's new ideas about evaluating teams, positions, and recruiting say about the program's past, present, and future. I find that after adjusting for schedule difficulty, the coaching performance of the legendary LaVell Edwards (1972–2000) resulted in 3.8 more points in margin of victory than that of Bronco Mendenhall (2005–2015), and 10.8 more points than that of Gary Crowton (2001–2004). I also find that the best of the LDS talent pool is concentrated at the most important positions; that BYU is currently operating near its optimum in acquiring players at the most important position (quarterback), but suboptimally at the second and third most important positions (left tackle and right defensive end/outside linebacker); that the recent hiring of a coach with well-known recruiting ability is expected to empower BYU to shift closer to the optimum; and, finally, that entering a "Power" football conference would affect the program's recruiting ability.

The second part details the program's response to the analytics revolution. I gauge the extent to which BYU football has adopted analytics and conclude that the outgoing staff has done so to a substantial though nonexhaustive degree, while the incoming staff's receptiveness

---

8. Kevin J. Worthen, "The NCAA and Religion: Insights about Non-State Governance from Sunday Play and End Zone Celebrations," *Utah Law Review* 2010, no. 1 (2010): 123–40.

9. Lane Demas, *Integrating the Gridiron: Black Civil Rights and American College Football* (New Brunswick, N.J.: Rutgers University Press, 2010), 102–33; Darron T. Smith, *When Race, Religion, and Sport Collide: Black Athletes at BYU and Beyond* (Lanham, Md.: Rowman and Littlefield, 2016).

10. This article will not argue for the merits of analytics. The premise of this paper is that analytics can confer competitive advantages; but it in most cases, it should supplement, not replace, experiential football knowledge, and success without analytics is possible.

to analytics varies among its top-level coaches, from warm to unknown. Results of this study hold implications for how Church-affiliated institutions respond to changes in the intellectual climate.

Overview of the Sports Analytics Revolution

Before discussing my investigation, I provide a brief overview of the analytics revolution. As shown in Michael Lewis's popular book *Moneyball,* intellectual underpinnings for the growth of sports analytics originated with Bill James, a University of Kansas graduate in economics and literature and a factory night-watchman.[11] James keenly observed how traditionally regarded baseball statistics like fielding percentage inadequately captured player abilities. He self-published this and other findings in 1977 as *Baseball Abstracts,* with a readership of seventy-five.[12] The advent of computer databases expedited data collection and enabled James to draw contributions from other technically competent people in creating a body of data and analysis. He systematized those ideas, which overturned much conventional wisdom, by founding the field of Sabermetrics, named after the Society for American Baseball Research (SABR).

As Baumer and Zimbalist documented,[13] free agency and collective-bargaining agreements in Major League Baseball drove up player salaries and enabled wealthy teams to acquire players unaffordable to small-market teams. This forced the latter to scramble for ways to compete with limited budgets. Consequently, the ideas of James and his followers, especially in player evaluation, were then funneled into baseball via Oakland A's general manager (GM) Billy Beane as part of Beane's quest to find undervalued players. The first to apply those ideas extensively, Beane created division-winning teams with payrolls among the lowest in baseball. Similarly poor teams like the Tampa Bay Rays and Pittsburgh Pirates followed, enabling themselves to boost competitiveness vis-à-vis wealthier clubs. But, as the *Economist* notes, nothing would stop the wealthy from also acquiring analytics-oriented GMs: "After years of sticking with traditionalists in their front offices, big-market clubs are increasingly acquiring brand-name GMs to assemble

11. Michael Lewis, *Moneyball: The Art of Winning an Unfair Game* (New York: W. W. Norton, 2013).

12. Lewis, *Moneyball,* 65–66.

13. Benjamin Baumer and Andrew Zimbalist, *The Sabermetric Revolution: Assessing the Growth of Analytics in Baseball* (Philadelphia: University of Pennsylvania Press, 2014), 21–22.

their star-studded rosters."[14] Seeing the advantage analytics conveyed, basketball and football teams joined in.[15]

The revolution met resistance from traditionalists. Highly successful Atlanta Braves GM John Schuerholz disparaged statisticians as people "with green visors and rubber bands around their sleeves and pocket guards with pens and calculators in their shirt pockets."[16] More recently, basketball Hall-of-Famer Charles Barkley quipped, "All these guys who run these organizations who talk about analytics, they have one thing in common. They're a bunch of guys who ain't never played the game, and they never got the girls in high school, and they just want to get in the game."[17] Schuerholz's and Barkley's remarks reflected the sports establishment's angst over statistical analysis possibly supplanting traditional scouting methods. Fortunately, this tension was diffused somewhat; the latest book from the leading sabermetrics website BaseballProspectus.com contained two chapters on scouting, suggesting that analytics could improve scouting, not supplant it.[18]

The Revolution Shines Light on BYU Football

I begin the investigation by exploring three of the analytics revolution's prominent ideas and their relevance to the BYU football program. The first is the idea of evaluating teams using "computer polls." The NCAA used them to qualify teams for postseason games. Popular discontent led the association to phase out their influence, but the strength of their logic endures. The second idea involves the importance of the player tasked with protecting the passer's blind side, made popular in book and film. The third idea, unique to college sports, is predicting where high school players will choose to attend college.

---

14. D. R., "The Cult of the Genius GM," *Economist,* October 15, 2014, http://www.economist.com/blogs/gametheory/2014/10/brains-v-brawn-baseball.

15. Baumer and Zimbalist, *Sabermetric Revolution,* 87–101.

16. John Schuerholz, *Built to Win: Inside Stories and Leadership Strategies from Baseball's Winningest General Manager* (New York: Warner, 2006), 29.

17. Matt Moore, "VIDEO: Charles Barkley Declares War on Math with Rant against 'Analytics,'" *CBS Sports,* February 11, 2015, http://www.cbssports.com/nba/eye-on-basketball/25065619/video-charles-barkley-declares-war-on-math-with-rant-against-analytics.

18. Jason Parks, "How Are Players Scouted, Acquired, and Developed?" in *Extra Innings: More Baseball between the Numbers,* ed. Steve Goldman (New York: Basic, 2012), 133–54; Jason Parks, "From the Buscone to the Big Leagues: How Is Latin-American Talent Acquired and Developed?" in Goldman, *Extra Innings: More Baseball between the Numbers,* 175–97.

Computer Polls

The analytics revolution produced new ideas for evaluating teams that illuminate BYU football's historical performance. Among the earliest exposures fans had to advanced statistics was through computer polls like Sagarin, Pomeroy, and Massey, which were used to choose contestants in the Bowl Championship Series (BCS) early in its inception.[19] College teams play a minuscule fraction of the 118 other teams each season. This lack of round-robin format means that opponent strength for each team varies wildly. Consequently, simple win-loss records insufficiently describe a team's abilities, so sportswriters and coaches, respectively, must rank teams in the Associated Press (AP) and Coaches polls. But humans are subject to biases.[20]

When computer polls rate each school's performance, they treat each game as a single observation and factor in the margin of victory and whether the game was played at home or on the road. They also control for opponent strength because midway through the season, each team has played another team, which has played another, to the point that all teams are interconnected by games—with plenty of redundancy. They use a statistical method called regression analysis that allows them to incorporate those variables simultaneously. Though imperfect, computer polls correct human biases. Their formulas are kept confidential to avoid manipulation, but their results have invited peer review. Fair and Oster have found that while averaging the rankings of six computer polls used by the BCS created powerful predictive ability, they fared no better than Las Vegas betting markets.[21]

The logic of the computer polls enables us to examine BYU's historical performance. At this point, readers should be alerted that the remainder of this subsection is the most technical portion of the article. I follow the structure of computer polls by constructing a model with each game as the unit of analysis, and use a HOME variable, with high (1),

---

19. The BCS was formed to match the best teams in games at the end of the season.

20. Sportswriters tend to vote more favorably toward, among other things, teams in their own states, and teams that won in games televised nationally. See B. Jay Coleman, Andres Gallos, Paul M. Mason, and Jeffrey W. Steagall, "Voter Bias in the Associated Press College Football Poll," *Journal of Sports Economics* 11, no. 4 (2010): 397–417, doi:10.1177/1527002509346823.

21. Ray C. Fair and John F. Oster, "College Football Rankings and Market Efficiency," *Journal of Sports Economics* 8, no. 1 (2007): 3–18, doi:10.1177/1527002505276724.

medium (0), and low (–1) to denote home, neutral, and road games, respectively. The model differs from computer polls in that instead of including all college football games in one season, I use only BYU games across different seasons.

This difference creates two problems that need modifications to maintain the same power of computer polls. First, because I include only BYU games, its opponents are not interconnected by games to control for opponent difficulty. Thus, I control for opponent strength by incorporating the opponent's final Massey ranking, available from masseyratings.com. Second, because I include only BYU games across seasons, the data are a time series instead of a cross-section like the computer polls. To yield correct test statistics, Ordinary Least Squares (OLS), the bread and butter of regression modeling, requires the error terms to be homoscedastic, and normally and independently distributed. Time-series data often violate this third requirement. If that is the case, a different regression technique is required.

Using computer poll methodology, I construct an OLS model on the 552 games in which BYU has played from 1972, the year LaVell Edwards became head coach, to the end of the 2015–16 season. The game results are also available from masseyratings.com. I set margin of victory (MOV) as the dependent variable, with binary explanatory variables CROWTON and MENDENHALL (EDWARDS is the baseline), and HOME and OPP_MASSEY_RANK as controls. I apply the Durbin-Watson (DW) test to determine whether the error terms are independent as required. A DW test statistic significantly different from 2 would lead one to reject the null hypothesis that the errors are independent. The statistic is 1.6859 ($p < .0001$); accordingly, I replace the OLS with generalized least squares (GLS), the method suited for autocorrelated data.[22]

Because how the error term in one game relates to the prior one is unknown, I allow the model to determine that relationship empirically, making the model empirical generalized least squares (EGLS).[23] With the same variables as the OLS, I construct the following EGLS model of autoregressive order one, AR(1). This means that the error term in the model for each game equals the error term of one prior game multiplied by an empirically determined constant. Results of both regressions are found in table 1.

---

22. Thomas P. Ryan, *Modern Regression Methods,* 2d ed. (Hoboken, N.J.: Wiley, 2009), 68.

23. Jon Fox, *Applied Regression Analysis and Generalized Linear Models,* 2d ed. (Thousand Oaks, Calif.: Sage, 2008), 439–40.

Table 1. Impact on Margin of Victory OLS vs. EGLS

Coefficient	OLS (1972–2015) n = 552	EGLS (1972–2015) n = 552
INTERCEPT	–3.93132**	–3.793561**
OPP_MASSEY_RANK	0.20677****	0.204785****
HOME	3.114411****	3.184117****
CROWTON	–9.79724***	–9.727855**
MENDENHALL	–2.61446	–2.577163
R^2/Pseudo-R^2	0.357	0.357
Proportion of Games Correctly Predicted	0.786	0.783
Akaike Information Criterion	4701.214	4686.212

#p < .10; *p < .05; **p < .01; ***p < .001; ****p < .0001.

The values in the columns represent the effect the variables have on margin of victory. Unsurprisingly, the OLS and EGLS have nearly identical estimates; the OLS estimator on autocorrelated data, though it yields incorrect test statistics, is still unbiased, like the GLS family. The only qualitative difference between the OLS and EGLS is in the coefficient CROWTON, significant at the 0.001 level in the OLS and 0.01 level in the EGLS. The control variables in this model are all highly significant in the directions expected: easier opponents and home field advantage resulted in larger margins of victory. Both models correctly forecast the win-loss outcome of over 78 percent of games in the sample. As measured by the R^2 value (Pseudo-R^2 for the EGLS), both models explain 35.7 percent of the variation in MOV. The Akaike Information Criterion (AIC), which measures information loss in the models, favors the EGLS. The error terms in the OLS model are strongly correlated, theoretically throwing significance tests off, so I proceed with the EGLS.

The EGLS has a parameter relating the error term in this time period (game in this case) to the previous one that the OLS does not, and equals 0.16828912 in this model. A question arises about whether the error terms are correlated to not only one previous game but more. A model in which the error term in one period is related to the ones in two prior periods is the AR(2) model. I rerun the EGLS, assuming an AR(2) structure, and find the parameters for one and two prior periods to be 0.15897588 and 0.02503452, respectively. The correlation structure would be:

$$\varepsilon_g = 0.159\varepsilon_{g-1} + 0.025\varepsilon_{g-2} + \nu_g$$

However, the 95 percent confidence interval for the second-order parameter is [−0.05680647 0.1065413], which contains zero, indicating that it is not statistically different from zero, providing rationale for discarding the AR(2) and keeping the AR(1) model, shown below:

$$MOV_g = \\ -3.794 + 0.205OPPMASSEY_g + 3.184HOME_g - 9.728CROWTON_g + 0.168\varepsilon_{g-1} + \nu_g$$

The *g* denotes the current game and *g–1* the prior game. Notice the MENDENHALL coefficient is insignificant. The computer polls, which produced this tool for evaluating teams, demonstrate that Mendenhall's performances roughly equaled that of Edwards's. Some may counter that this is unfair to Edwards because Edwards elevated the program to national prominence. "BYU wasn't BYU before LaVell," captures this claim. Mendenhall likewise inherited a team mired in consecutive losing seasons, but unlike Edwards, they were losing seasons with a storied brand, and all the recruiting advantages that come with it. Edwards deserves a grace period for this reason.

I rerun the regression and find the statistical equality between the EDWARDS and MENDENHALL coefficients to be sensitive to changes in the number of grace years. Granting Edwards just a one-year grace period makes his performance statistically better than Mendenhall's at the 10 percent level (p = 0.0941). Extending the grace period to three seasons makes Edwards's performance statistically better than Mendenhall's at the 5 percent level (p = 0.0470). Each iterative model can be found in appendix B for one- to four-season grace periods, but I present the models with zero-, one-, and three-year grace periods in table 2 to show how the significance of MENDENHALL coefficient changes.

The model fit, both in terms of the variance explained and the win-loss outcome of games in the sample correctly predicted, appears to improve (though not monotonically) as we allow Edwards more time, which suggests that granting Edwards the grace period is appropriate. I do not support granting Mendenhall the same grace period both for substantive reasons I listed above and because model fit deteriorates when I do so. But Edwards's performance remains better than Mendenhall's even if I do. I include the would-be results in appendix B. Hence, I arrive at the following predictive equation:

$$MOV_g = \\ -2.901 + 0.208OPPMASSEY_g + 3.173HOME_g - 10.811CROWTON_g \\ - 3.798MENDENHALL_g + 0.147\varepsilon_{g-1} + \nu_g$$

Table 2. EGLS-AR(1), Impact on Margin-of-Victory, Grace Periods for LaVell Edwards

Variable	No Grace Period (1972–2015) n=552	1-Year Grace Period (1973–2015) n=541	3-Year Grace Period (1975–2015) n=518
INTERCEPT	–3.793561**	–3.466628	–2.901024**
OPP_MASSEY_RANK	0.204785****	0.206912****	0.207504****
HOME	3.184117****	3.195950****	3.172963****
CROWTON	–9.727855**	–10.207137**	–10.811242***
MENDENHALL	–2.577163	–3.184314#	–3.798108*
ε_{g-1}	0.1624007*	0.1480461*	0.146773*
Pseudo-R^2	0.357	0.366	0.365
% Games Predicted	0.783	0.767	0.789

#p < .10; *p < .05; **p < .01; ***p < .001; ****p < .0001.

The logic of computer polls allows us more apt comparisons of BYU under different head coaches than polls that survey journalists or coaches. The methods undergirding the computer polls enable performances to be adjusted for opponent difficulty and the home-away factor. With those controls, I conclude that BYU football averaged 3.8 more points in margin of victory under Edwards than under Mendenhall, and 10.8 more points under Edwards than under Crowton.

The "Blind Side" Thesis

In addition to evaluating teams, the analytics revolution also changed how positions are valued. Quarterback (QB) has long been recognized as the most important position. The center "snaps" the ball to the QB to begin the play, and the QB decides what to do with the ball. Eyes naturally follow the player holding the ball. A key discovery in the past decade was that one particular offensive line (OL) position, the left tackle (LT), who does not carry the ball but is tasked with protecting the quarterback's blind side, is second most important.

The rise of the LT's value began when, as Alamar documented, returns from passing rose over time.[24] Average yards advanced from pass

24. Benjamin C. Alamar, "The Passing Premium Puzzle," *Journal of Quantitative Analysis in Sports* 2, no. 4 (2006): article 5, doi:10.2202/1559-0410.1051.

attempts increased from 4.66 in 1960 to 5.8 in 2005.[25] Lewis explicated the causal mechanism behind this rise in his popular book *The Blind Side.* Coaches caught onto the fact that the extensive width of the football field can be exploited by having receivers spread out more, isolating them, rendering them easier to throw to.[26] Consequently, teams passed more, causing a rise in the values of a QB's longevity. Just as the insurance premium for an asset rises in tandem with the asset price, the price of protection for a QB, the LT's salary, increased. Previously undervalued, the LT became recognized as the second-most important position in the National Football League (NFL) and was paid accordingly.

Duly appreciated, the LT's value drew analytical scrutiny. Alamar and Weinstein-Gould calculated, using a convenience sample of seven teams for each of three 2007 games, the relative contributions of each of the five OLs at creating time in keeping defensive linemen (DLs) from the QB's space.[27] Then they related the time created to the percentage of throws the QB completed. They estimated that the New York Jets' trade of lineman Pete Kendall to the Washington football team for Adrien Clarke resulted in their QB connecting three percentage points less of his passes. Alamar and Goldner subsequently translated time created for QBs into yards LTs advanced for their teams.[28]

Additionally, since the most important position is the passer, and the second most important position is the lineman who protects his blind side, it logically follows that the third most important position would be the player on the other team trying to move past the LT and rush the quarterback. In football, behind the DLs are linebackers (LBs). As Lewis explained, in a 4–3 defense (four DLs and three LBs), the most common alignment, the right defensive end (RDE) is the primary pass rusher. But in the 3–4 defense (three DLs and four LBs), the outside linebacker (OLB) is the primary pass rusher.[29] Lewis portrayed OLB Lawrence

---

25. Alamar, "Passing Premium Puzzle," 3.

26. Michael Lewis, *The Blind Side: The Evolution of a Game* (New York: W. W. Norton, 2006; 2009), 103–14.

27. Benjamin C. Alamar and Jesse Weinstein-Gould, "Isolating the Effect of Individual Linemen on the Passing Game in the National Football League," *Journal of Quantitative Analysis in Sports* 4, no. 2 (2008): article 10, doi:10.2202/1559-0410.1113.

28. Benjamin C. Alamar and Keith Goldner, "The Blindside Project: Measuring the Impact of Individual Offensive Linemen," *Chance* 24, no. 4 (2011): 25–29, doi:10.1080/09332480.2011.10739883.

29. Lewis, *Blind Side,* 127.

Taylor's wreaking havoc on QBs as the driving force behind demand for LTs.[30] In light of this, I examine how BYU has fared in acquiring players at these three most important positions.

The QB position has historically accrued fame for BYU. BYU QBs have won the Heisman Trophy (Ty Detmer),[31] two Super Bowl most valuable player awards (Jim McMahon and Steve Young), and countless other accolades. Today, QB remains a position rich in LDS talent. In the past decade and a half, BYU landed two high-school QBs rated the best nationally by recruiting agencies: Ben Olson of Thousand Oaks, California (2002), and Jake Heaps of Sammamish, Washington (2010). In years where BYU did *not* sign the highest-rated QB in the nation, there was little difference between the best and what BYU signed. The 2015 season was illustrative of the QB abundance BYU typically enjoys: After the Heisman candidate Taysom Hill suffered a season-ending lisfranc injury in the first game, he was replaced by Tanner Mangum, the co-most valuable player with future Heisman-winner Jameis Winston at an Elite 11 high school camp.

After acquiring QBs, developing them has been generally unproblematic. BYU has produced a continuous stream of NFL QBs since the sunset of the golden LaVell Edwards era: Brandon Doman (2002, San Francisco 49ers); John Beck (2006, Miami Dolphins); and Max Hall (2010, Arizona Cardinals). A break occurred in the mid-2010s when Heaps's talent failed to materialize and Hill's injury and resultant loss of speed clouded his NFL chances. But with Mangum and 2015 St. George, Utah, signee Kody Wilstead, who was also selected to participate in the same Elite 11 QB camp, one can expect the stream of NFL quarterbacks to continue. BYU operates close to its frontier at QB.

Like QB, OL is a position in which BYU has been historically strong. Draft data from the *Salt Lake Tribune*'s Cougarstats.com show that from 1983 to 1999, twenty BYU OLs were drafted into either the NFL or the now-defunct United States Football League, with the number of DLs drafted a distant second (eight). The light has dimmed, however, with only two more OLs drafted since. BYU has dropped from the optimum at recruiting for the second most important position.

With the importance of LTs and DEs/OLBs in mind, I break down how BYU has fared at acquiring the best players at those positions. I include all LBs, DLs, and OLs, except centers. Centers snap the ball

30. Lewis, *Blind Side,* 15–27.

31. The Heisman Trophy is awarded annually to the best college player.

through their legs to the QB and tend to be smaller and less interchangeable with other OLs. For the other positions, the best pass rusher plays OLB/DE, regardless of where he played in high school. Data on recruits are available from Scout.com from 2002 on. Due to BYU's honor code limitations, I restrict the investigation to LDS players to whom BYU has offered a scholarship. I tabulate high school recruits ranked in the top twenty-five at their positions, and junior college (JC) recruits ranked in the top ten. Table 3 displays all the players who meet the criteria outlined above.

Most striking is the preponderance of Polynesian-lineage surnames in table 3. Deploying a name method previously used to identify ethnic Asians on National Merit Scholars lists, combined with information from Scout.com articles,[32] I run frequencies in table 4. Polynesians in this elite group opted to play elsewhere by a ratio of over two-to-one. BYU missed on 64.1 percent of elite LDS recruits at the second and third most important positions. However, a Fisher Exact Test of independence, used to determine whether two groups are similar, shows insufficient evidence that LDS athletes of Polynesian descent were less likely to sign with BYU than those of non-Polynesian descent. This indicates that the issue may be a general problem with recruiting players for the positions.

Of the total recruits at these positions BYU targeted, three-quarters are of Polynesian descent. This figure represents the coordinate at which sports, culture, and faith meet. Houghton has analyzed how the evolutionary development of muscular Polynesian physique was likely a product of natural selection for the oceanic environment.[33] According to Houghton, muscle tissue "allows for rapid variation in heat production," enabling Polynesians to survive both cold, windy, and wet maritime travel on one hand and hot life on land on the other.[34] Large build combined with a warrior culture dovetail with football. Underwood has documented the strong presence of Polynesians in the LDS Church and, hence, in BYU football.[35]

---

32. See Ron Unz, "The Myth of American Meritocracy," *American Conservative,* November 28, 2012, 19, http://www.theamericanconservative.com/articles/the-myth-of-american-meritocracy/.

33. Philip Houghton, "The Adaptive Significance of Polynesian Body Form," *Annals of Human Biology* 17, no. 1 (1990): 19–32, doi:10.1080/03014469000000752.

34. Houghton, "Adaptive Significance," 28.

35. Grant Underwood, ed., *Pioneers in the Pacific: Memory, History, Cultural Identity among the Latter-day Saints* (Provo, Utah: BYU Religious Studies Center, 2005).

Table 3. Elite LDS Linemen and Linebackers BYU Recruited (Excluding Centers) 2002–15

Year	Players BYU Offered but Missed Position (Rank) Name/School Enrolled	Players BYU Acquired Position (Rank) Name
2002	DT (1) Haloti Ngata/Oregon DE (5) J. T. Mapu/Tennesee OL (20) Ryan Carter/Florida	DT (JC 6) Scott Young OL (15) Jake Kuresa
2003		OL (2) Ofa Mohetau DT (16) Brian Soi
2004	OL (JC 1) Taitusi Lutui/USC	
2005	DE (JC 5) C. J. Ah You/Oklahoma LB (11) Kaluka Maiava/USC OL (1) Adam Hawes/Arizona State	OL (8) Matt Reynolds
2006	OL (JC 2) Fenuki Tupou/Oregon DT (17) Sione Fua/Stanford	
2007		
2008	DT (25) Sealver Siliga/Utah OLB (9) Uona Kaveinga/USC	DT (JC 2) Tevita Hola DT (JC 9) Bernard Afutiti
2009	OLB (1) Manti Te'o/Notre Dame OG (3) Xavier S'ua Filo/UCLA MLB (17) L. T. Filiaga/Utah DT (15) Latu Heimuli/Utah	OLB (11) Kyle Van Noy
2010	DT (10) Ricky Heimuli/Oregon	MLB (8) Zac Stout OT (11) Graham Rowley DE (19) Bronson Kaufusi
2011		
2012	OLB (23) Vince Biegel/Wisconsin OG (21) Brandon Fanaika/Stanford	DE (23) Troy Hinds MLB (21) Butch Pau'u
2013		OG (16) Brayden Kearsley
2014	OG (2) Damien Mama/USC OG (5) Viane Talamaivao/USC DT (6) Bryan Mone/Michigan	
2015	OG (2) Tristen Hoge/Notre Dame OG (8) Christian Folau/Oregon State DT (5) Breiden Fehoko/Texas Tech OG (14) Semisi Uluave/California	

MLB: Middle Linebacker; DT: Defensive Tackle (one of the DL); OG: Offensive Guard (one of the OL); OT: Offensive Tackle (one of the OL).

Table 4. Frequency of Elite LDS Potential Recruits by Heritage

	Missed	Acquired	Total
Non-Polynesian	4 (10.3%)	6 (15.4%)	10 (25.6%)
Polynesian	21 (53.8%)	8 (20.5%)	29 (74.4%)
Total	25 (64.1%)	14 (35.9%)	39 (100.0%)

Harnessing the perceived abilities of a talented subpopulation has precedents. Morris detailed how the Taiwanese government saw the "physical gifts" of the country's Austronesian natives and expended funds to "excavate" their talent for the national baseball team.[36] Though less than 2 percent of Taiwan's population, the aboriginals comprised eleven of the twenty-five players on the baseball squad at the 2004 Athens Olympics, and the first two Taiwanese players in Major League Baseball.[37]

BYU enjoys a structural advantage with Polynesian-heritage prospects: it can reap economies of scale in recruitment. Although Polynesians constitute an enormous proportion of college football players relative to their population, only a few other schools, like USC, can find it economical to direct their resources to this demographic. The outgoing BYU staff's infrastructure built by Mendenhall and his management consultant, Paul Gustavson, doubtlessly employed an approach others could not replicate. In fact, at the heart of its organizational philosophy was an idea found in Porter's "What Is Strategy?"[38] Porter argued that a firm must be doing something no one else is doing, or doing something differently from what other firms are doing. Otherwise, competitors would copy its strategy and erode its advantage. As Porter explained, "A company can outperform rivals only if it can establish a difference that it can preserve."[39]

Mendenhall and Gustavson pursued nonreplicable strategies by (1) exploiting the maturity and leadership skills of returned-missionary players through assigning them responsibilities usually assumed by coaches and staff, such as conducting practices and organizing off-field events;[40] (2) channeling BYU's uniquely religious nature as a higher purpose to ignite players to "play from the deepest place possible [their faith];"[41] and (3) taking advantage of the BYU Honor Code and the resultant lower levels of toxins in players' bodies by implementing endurance-training methods that coaches believed would help BYU

36. Andrew D. Morris, *Colonial Project, National Game: A History of Baseball in Taiwan* (Berkeley: University of California Press, 2011), 80.

37. Morris, *Colonial Project, National Game,* 165.

38. Michael E. Porter, "What Is Strategy?" *Harvard Business Review* 74, no. 6 (1996): 61–78.

39. Porter, "What Is Strategy?" 62.

40. Paul Gustavson and Alison von Feldt, *Running into the Wind: Bronco Mendenhall—5 Strategies for Building a Successful Team* (Salt Lake City: Shadow Mountain, 2012), 120.

41. Gustavson and von Feldt, *Running into the Wind,* 227.

outlast opponents.[42] How Mendenhall and Gustavson interacted with BYU's unique demographic endowment is unclear. It is known that Crowton conducted luaus for potential recruits.[43]

Recent coaching changes should help BYU in recruiting Polynesian players. During the writing of this article, Mendenhall accepted the position of head coach at the University of Virginia, and BYU hired Kalani Sitake in mid-December 2015 to replace him. The affable Sitake is known for his recruiting prowess. Upon his hiring, athletic director Tom Holmoe said of him, "He is an outstanding leader and coach, an exceptional recruiter."[44] Though Tongan-American, Sitake remarked, "I'm kind of offended when they say I'm a Polynesian recruiter. Some players happen to be Polynesian, some African-American, some white. I value all of them. I'm just a coach who happens to be Polynesian."[45]

Sitake's statement is true enough. Nonetheless, one would still expect Sitake to help in recruiting this talented demographic. Mirabile and Witte, in the most comprehensive study on college football recruiting to date (more on this below), found that a series of variables that relate the recruit to a particular school, which they dubbed the "affinity cohort," significantly influenced the likelihood a recruit would sign.[46] Among them was whether the recruit had family ties to the school. For mid- and high-rated recruits, family ties tripled the probability a recruit would choose the school.[47] Considering the affinity factor, one would expect Sitake's ties to the Polynesian community to make a difference.

In summary, ideas of the analytics revolution have led to the conclusion that Edwards outperformed Mendenhall who outperformed Crowton; that BYU's historical overachievement for its talent level has been

---

42. See Trevor Matich, interview by Spencer Linton and Jarom Jordan, *BYU Sports Nation,* BYUTV, September 14, 2015, available on *YouTube,* https://www.youtube.com/watch?v=-kbbYwT4V50.

43. See Bruce Feldman, "A Recruiting Pitch of Another Kind," *ESPN,* May 28, 2002, http://espn.go.com/gen/s/2002/0527/1387550.html.

44. Thomas A. Holmoe, in "Sitake Comes Home," *BYU Magazine* (Winter 2016): 8.

45. Doug Robinson, "Kalani Sitake: 'The Protector' Puts Family, Cougars, under His Wing," *Deseret News,* March 25, 2016, http://www.deseretnews.com/article/865650869/Kalani-Sitake-The-Protector-puts-family-Cougars-under-his-wing.html?pg=all.

46. McDonald Paul Mirabile and Mark David Witte, "A Discrete-Choice Model of a College Football Recruit's Program Selection Decision," *Journal of Sports Economics* (2015): 1–28, doi:10.1177/1527002514566278.

47. Mirabile and Witte, "Discrete-Choice Model," 17.

due to its concentration of talent in the most important positions; that currently, BYU performs near what is possible in recruiting passers, but not those who protect the passer's blind side nor those pressuring opposing passers.

Recruiting

Sitake's recruiting skill stems from personality and effort. That does not mean the analytics cannot identify factors that affect the probability a targeted recruit will sign. Unlike professional sports, wherein teams draft incoming players from the level below, college teams must convince high schoolers, who voluntarily sign with any program that has offered them a scholarship, to choose them. Hence, the rise of analytics would naturally launch numerous studies on college recruiting. Valuable to BYU are papers that predict whether a prospect will sign with a particular school. DuMond, Lynch, and Platania authored the first paper of this kind.[48] They used a conditional probit model based on Rivals.com data and found that a school's AP ranking the prior year, membership in a BCS conference, whether or not the school has a bowl ban, stadium capacity, and a tier-one academic ranking, among other variables, affected the likelihood a recruit would sign.

Subsequently, Mirabile and Witte improved on the model of DuMond and his coauthors with a study of their own, mentioned above. They used eleven years of data (2002–12), compared to three for DuMond.[49] This gave Mirabile and Witte a total of 19,815 players and 113,384 schools. By comparison, the DuMond sample contained 3,395 players and 13,394 schools. The larger sample size enabled Mirabile and Witte to partition the sample into three—one for lower-rated recruits (rated two stars), one for mid-rated recruits (three stars), and one for higher-rated recruits (four or five stars). DuMond and his coauthors merely included the rating as a covariate.[50] This difference is important because recruits of differing qualities exhibit different preferences. For instance, Mirabile and Witte found that lower-rated recruits value academics more strongly in their decisions.[51] The data and models the two studies used

48. J. Michael DuMond, Allen K. Lynch, and Jennifer Platania, "An Economic Model of the College Football Recruiting Process," *Journal of Sports Economics* 9, no. 1 (2008): 67–87, doi:10.1177/1527002506298125.

49. Mirabile and Witte, "Discrete-Choice Model," 8.

50. DuMond, Lynch, and Platania, "Economic Model," 77.

51. Mirabile and Witte, "Discrete-Choice Model," 20.

were similar: Mirabile and Witte used data from Scout.com; DuMond and his coauthors used data from Rivals.com, both top recruiting sites; the former used a conditional logit regression, the latter a conditional probit.[52] Both probit and logit have binary dependent variables; the probit assumes the data to be normally distributed, logit log-normally.

Both models find that, counter to prevailing wisdom, a school's NFL placement ability had no effect on recruits.[53] Thus BYU's recent poor NFL output numbers should not constitute a pressing concern. Mirabile and Witte found a host of other statistically significant variables, many with implications for BYU. Due to space limitations, I focus on just one with a large coefficient: membership in a BCS conference.

Both models also found a school's BCS (now P5) membership to be a statistically significant factor.[54] Mirabile and Witte discovered that a prospect is 31 percent more likely to choose a P5 school over a non-P5 school.[55] Currently, BYU plays as a football independent unaffiliated with a conference. Mendenhall and Holmoe have expressed desires for P5 inclusion. Holmoe recognized that the widening resource gap between the P5 and G5 would diminish BYU's ability to compete.[56] BYU neared prospective P5 status when the Big XII conference announced it was seeking to expand membership on July 19, 2016. But after a long, drawn-out selection process, the conference publicly reversed course on October 17 of the same year.[57]

---

52. Mirabile and Witte, "Discrete-Choice Model," 15.

53. Mirabile and Witte, "Discrete-Choice Model," 15; DuMond, Lynch, and Platania, "Economic Model of the College Football Recruiting Process," 79.

54. The BCS conferences represent the top tier of college football. This club has been renamed the "Power Five" (P5). The second tier is the "Group of Five" (G5).

55. Mirabile and Witte, "Discrete-Choice Model," 17.

56. Quoted in Jerry Hinnen, "BYU AD Tom Holmoe: 'Intention' Is to Find Power Five Home in 'Near Future,'" *CBS Sports,* February 25, 2015, http://www.cbssports.com/collegefootball/eye-on-college-football/25081119/byu-ad-tom-holmoe-intention-is-to-find-power-5-home-in-near-future.

57. At the time of the July 19 announcement, BYU was widely held to be the leading candidate to join the conference. See Jake Trotter, "Houston, BYU Especially Would Add to Big 12's Athletics," *ESPN,* August 11, 2016, http://www.espn.com/college-football/story/_/id/17271490/many-big-12-expansion-candidates-actually-bolster-football-play. But BYU's inclusion faced opposition from LGBT advocates who believed the Honor Code was discriminatory. Many in the sports media reported that once BYU was eliminated from consideration, conference expansion was not nearly so attractive, so the university presidents opted to remain pat and receive more money from their television partners

The growth of analytics produced predictive models of player recruitment, enabling teams to identify factors that influence where a high school player chooses to play at the collegiate level. Preeminent among the findings was that membership in a P5 conference would help BYU's chances with signing a high school athlete by roughly 31 percent. Exclusion from a P5 conference will also leave BYU with a wealth gap vis-à-vis P5 members.

BYU Football Responds to the Revolution I: Mendenhall and analytics

The analytics revolution has not pervaded every team equally. Baumer and Zimbalist found that as of 2012, four major league baseball teams—Atlanta, Colorado, Miami, and Philadelphia—had no front-office employees devoted to analytics.[58] Alamar added that even among teams known to use analytics, the sophistication in their use varies.[59] Davenport, in an industry white paper, classified analytic practices into two categories: "table stakes" analytics, which are becoming commonplace in sports, and "frontier" analytics, used aggressively by only a few teams.[60] Table stakes analytics relevant to college football include external data sources, descriptive analytics on players, game simulations, and game-tactic analysis. "Frontier" analytics include video motion-capture data, locational/biometric data, open data analysis by fans, engaging players in analytics, and gathering and using proprietary data.[61] Where does BYU football fall on this spectrum? None outside the program can definitely say. Due to obvious competitive reasons, teams often maintain secrecy about their analytic practices. For instance, Neuroscout LLC, a company that uses EEG machines to measure how quickly batters

---

instead. See Pete Thamel, "Big 12 Decides Not to Expand Conference," *Sports Illustrated,* October 17, 2016, http://www.si.com/college-football/2016/10/17/big-12-expansion-proposal-rejected. The growing assertiveness of LGBT advocacy is something BYU and other Church-affiliated institutions must engage in the foreseeable future, whether or not the reports are correct.

58. Baumer and Zimbalist, *Sabermetric Revolution,* 26.

59. Benjamin C. Alamar, *Sports Analytics: A Guide for Coaches, Managers, and Other Decision Makers* (New York: Columbia University Press, 2013), 13.

60. Thomas H. Davenport, *Analytics in Sports: The New Science of Winning* (Portland, Ore.: International Institute for Analytics, 2014), 6–7, http://www.sas.com/content/dam/SAS/en_us/doc/whitepaper2/iia-analytics-in-sports-106993.pdf.

61. Davenport, *Analytics in Sports,* 16.

recognize pitches, services unnamed Major League Baseball teams.[62] BYU statistics professor Shane Reese has advised several of the school's sports programs, including basketball,[63] and has offered his services to Mendenhall.[64] Mendenhall expressed interest but did not meet with Reese again. Not until seven years later did Mendenhall meet with members of the statistics department.[65] After he left BYU and took the head coaching position at the University of Virginia, his new athletic director, Craig Littlepage, described him as "data-driven."[66] Ava Wallace of the *Washington Post* wrote on December 7, 2015, that Mendenhall "likes advanced statistics and depends on behavioral organization to implement his system."[67]

Involving Players in Analytics

Davenport said that one approach to analytics is to involve players.[68] BYU's connection to analytics began long before Mendenhall. Former BYU and NFL quarterback Virgil Carter published the first known paper on football analytics in 1970. In "Technical Notes—Operations Research on Football," he divided the football field into ten-yard increments and calculated the expected points scored from each of those locations on the field. Expected points would equal a touchdown (seven

62. Larry Greenmeier, "'Neuroscout' Gets into Batters' Heads to Rate Hitters," *Scientific American,* July 1, 2014, http://www.scientificamerican.com/article/neuro-scout-gets-into-batters-heads-to-rate-hitters/.

63. Steven Potter, "The Numbers Game: BYU Rolls with Sports Analytics Trend," *Daily Universe,* May 8, 2014, http://universe.byu.edu/2014/05/08/20150223the-numbers-game-byu-rolls-with-sports-analytics-trend/.

64. Tad Walch, "Could a Statistical Model Detect Cheating NBA Ref?" *Deseret News,* August 16, 2007, http://www.deseretnews.com/article/695201262/Could-a-statistical-model-detect-cheating-NBA-ref.html?pg=all.

65. Emily Hellewell, "Statistics MVP: Grad Student Rates College Athletes," *BYU News,* April 12, 2016, https://news.byu.edu/news/statistics-mvp-grad-student-rates-college-athletes.

66. Craig Littlepage, "Bronco Mendenhall Introductory Press Conference Transcript" (Press Conference, John Paul Jones Arena, December 7, 2015), *Virginia: University of Virginia—Official Athletics Website,* http://www.virginiasports.com/sports/m-footbl/spec-rel/120715aaj.html.

67. Ava Wallace, "What's His Story? Bronco Mendenhall Explains Himself at Virginia," *Washington Post,* December 7, 2015, https://www.washingtonpost.com/sports/colleges/whats-his-story-bronco-mendenhall-explains-himself-at-virginia/2015/12/07/62becf8e-9d2e-11e5-bce4-708fe33e3288_story.html.

68. Davenport, *Analytics in Sports,* 9.

points), field goal (FG, three points), or safety (two points), multiplied by the percentage of times teams ended up scoring in drives from that portion of the field, minus the same for the opponent.[69] Particularly telling was Carter's description of the data-collection methodology: "Each of the 8,373 individual plays in these games was coded, punched, and entered into a computer, and all analyses were made on this database."[70] At the time of punch card computers, a BYU graduate was involved in football analytics. Four decades later, large online databases would give rise to the analytics revolution, and Carter's methodology became the basis of the Romer, White and Berry, and Knowlton and Fellingham papers to be examined further in this section.

When Carter's paper was published in 1970, he was no longer a member of the BYU football team with a stake in its success. But at least one player has been involved in analytics while playing football at BYU. In the Mendenhall era, two eventual NFL DEs majored in statistics: Ezekiel Ansah and Bronson Kaufusi. Ansah was drafted in the first round as the fifth selection in 2013, Kaufusi in the third round in 2016. Kaufusi's emphasis was in analytics, and he was involved in an analytics project for the team.[71] His involvement showed the program has adopted the "frontier" analytic practice of engaging players in the process.

Points Scored

There is no evidence that Mendenhall was instrumental in involving Kaufusi, but Mendenhall did demonstrate awareness of statistics. In *Running into the Wind,* we read: "As early as Bronco's first spring as head coach, he and his staff sought to pinpoint the game performance measures most closely correlated with winning. Building on some early research by the team under former head coach Gary Crowton, they studied twenty years of Cougar football and then college football as a whole to uncover the top ten statistics that indicate success. They aimed with laser-precision at finding the absolutely most crucial metrics."[72] The book does not mention what those metrics were. Fortunately, we can know more by matching the passage in the book to a speech Mendenhall relayed to the team:

---

69. Virgil Carter and Robert E. Machol, "Technical Notes—Operations Research on Football," *Operations Research* 19, no. 2 (1971): 541–44, doi:10.1287/opre.19.2.541.

70. Carter and Machol, "Operations Research on Football," 541.

71. Bronson Kaufusi, conversation with author, May 29, 2016.

72. Gustavson and von Feldt, *Running into the Wind,* 135.

"So we did our own little study, and not surprisingly, points scored was number one. Then points allowed was number two. Then, so all we tried to do was then say, OK, what mark was common amongst the team? And I wanted to give something tangible to our players. And that number happened to be twenty-four points, again, at BYU since the beginning of LaVell's era all the way until now, and it held again."[73]

Embedded within his statement is a clip of Mendenhall telling players that when BYU scored over twenty-four points, the team won 90 percent of the time. Winning is, by definition, scoring more points than one's opponent, so when Wallace said that Mendenhall liked "advanced statistics," she was probably talking about something other than "points scored." Later, I will discuss the program adopting a more useful system that computes how much each play contributes to points scored.

Execution

The Mendenhall-Gustavson regime emphasized execution over schematics. A full corpus of Mendenhall's quotes on this matter will not be retrieved. But the Broncoism "execute at a higher level" encapsulates this philosophy, which has empirical grounding: "Bronco and his staff were familiar with a study commissioned by Robert Kraft, the owner of the New England Patriots. The study found that only three to five plays per game really separate football dynasties from average teams. Although the researchers had expected that talent would be the factor that made the difference in those few plays, they discovered instead that the advantage went to the team with the most accurate execution of the planned play."[74] Mendenhall and Gustavson were holding team execution above individual talent. But the program exalted execution over in-game strategy as well. In this regard, whether it was wise for them to generalize based on an NFL study requires more investigation. Play-calling in the NFL is more homogeneous, meaning less wiggle room for strategy than in the NCAA. ESPN.com data from 2010 to 2015 show that NCAA teams passed the ball on an average of 45.1 percent of plays from scrimmage, with the middle half of the distribution spanning 40.9 percent to 50.5 percent. NFL teams from the same period passed the ball an average of 56.3 percent of the time, but its middle half of the distribution spanned 53.2 percent to 59.8 percent. The interquartile range is

73. Bronco Mendenhall, quoted in "Inside BYU Football (9/15/15)," *BYUTV,* September 15, 2015, http://www.byutv.org/watch/6596bb35-92c4-4b71-8945-e465f2918152/inside-byu-football-inside-byu-football-91515.

74. Gustavson and von Feldt, *Running into the Wind,* 156.

9.6 percentage points for NCAA Football Bowl Subdivision (FBS) teams and just 6.6 percentage points for NFL teams. An F-test for variance, used to determine whether the spreads of two groups are equal, shows that the variance in pass percentage was higher for the NCAA FBS than that for the NFL with high certainty ($p < 0.0001$). More room for strategy exists for college; thus the primacy of execution in the NFL may not apply in college.

Penalties

Another Mendenhall-Gustavson application of statistics is found in the attitude toward penalties. Facing local media concerns over the high number of penalties BYU had been incurring, Mendenhall said, "As I have said many times before, I don't see a correlation, at least a statistical correlation, between penalties and wins and losses. As [of] a few weeks ago, ourselves, TCU, and Utah were in the bottom of the league in penalties. Some of that comes with aggressive play. I don't condone it, but I would rather [not] be holding our players back than having them play too cautious."[75]

What Mendenhall said here is that the three winningest teams in the Mountain West Conference were also the most penalized. He even elucidated the cause: actively avoiding penalties resulted in timid play. This also applies to the NFL. As Michael Salfino notes on January 28, 2015, in the *Wall Street Journal,* in 2014 the two Super Bowl teams, New England and Seattle, ranked second and first in penalties committed, respectively. This phenomenon held the year before; Super Bowl champion Baltimore and runner-up San Francisco were first and second in penalties committed, respectively. The most successful teams racked up the most violations.

Mendenhall and Salfino singled out teams atop the success distribution. Hauge studied all NFL teams from 1995 to 2009, and obtained contradictory results.[76] In two separate regressions with only one variable each, she found a negative relationship between a team's winning percentage and its number of penalties in one regression and its penalty

75. Jillian Williams, "Mendenhall: We Are Anxious to Come Back Home and Play" (Press Conference, October 6, 2008, updated October 20, 2008), *The Official Home of the BYU Cougars,* http://byucougars.com/m-football/mendenhall-we-are-anxious-come-back-home-and-play.

76. Janice Hauge, "Incentive for Aggression in American Football," in *Violence and Aggression in Sporting Contests: Economics, History, and Policy,* ed. R. Todd Jewell (New York: Springer, 2011).

yards accrued in another.[77] In a third regression, she threw egregious penalties into the regression and concluded, "winning percentage is negatively correlated with both the number of offensive penalties and the total number of yards in offensive penalties. . . . Offensive penalties attributed to severe infractions has a negative and statistically significant effect on winning *percentage,* although the same is not true of defensive penalties."[78]

Hauge constructed two more models, using penalties to explain points scored and allowed. She found that if a team incurred fewer penalties than opponents, they tended to score more points. If they incurred more penalties than their opponents, they allowed more points.[79]

Informed football fans know that factors other than penalties affect winning and scoring. From a statistical standpoint, that Hauge failed to control for them in all her regressions leads to omitted variable bias. Winston, who advised the National Basketball Association's (NBA) Dallas Mavericks, offered analysis that not only corrected this deficiency, but would better adjudicate Mendenhall's belief about penalties because it used NCAA data.[80] Winston gathered yards per run, yards per pass, and penalty and turnover differences for all games involving the 128 NCAA FBS teams in 2014 as explanatory variables in an OLS regression on margin of victory.[81] He found all variables to have statistically significant impacts on margin of victory *except* penalty differential. This result, derived from more applicable and more granular data (because it used games as observations instead of seasons) and better methods by including proper control variables, justifies Mendenhall's distaste for

77. Hauge, "Incentive for Aggression," 40.

78. Hauge, "Incentive for Aggression," 39; emphasis in original. Hauge defined as "severe" penalties ten yards and over. Strangely, she included "points for" and "points against" as control variables in this regression. I leave it to the reader to interpret her result: penalties hurt a team's winning percentage apart from how many points it scores and allows.

79. Hauge, "Incentive for Aggression," 42.

80. Wayne L. Winston, "Lecture 45—5.4 What Makes NFL Teams Win?" (lecture, University of Houston, September 9, 2016), *Coursera,* https://www.coursera.org/learn/mathematics-sport/lecture/KogT1/5-4-what-makes-nfl-teams-win. Although the title of the lecture references the NFL, Winston directed the audience to an NCAA dataset and regression results, both available from the author upon request.

81. The aforementioned P5 AND G5 tiers form the upper-division FBS. Below the FBS is the lower-division Football Championship Series (FCS).

excessive attention to penalties and demonstrates his in-game tactical analysis to be consistent with analytics.

Biometric Data

In addition to Mendenhall's statements, the program's use of player-tracking technology offers clues on the intensity with which it adopted advanced statistics. The Mendenhall-Gustavson regime availed itself of biometric data. I mentioned earlier that the regime exploited the health benefits of the BYU Honor Code for perceived advantages in athletic performance. In the interview through which we know this, Matich also said that staff members "use high technology to train and monitor very closely the actual physiological state of players' bodies under stress. And they're able to take that up to the point to where they can get the maximum conditioning out of it, without going over and having it become detrimental."[82] The program under Mendenhall was adopting a "frontier" analytic practice by employing this sophisticated biometric program.

Fourth-Down Decisions

One can also assess whether Mendenhall was adopting analytics through his observable behavior. Among the best-known studies in the past decade has been Romer's paper about fourth-down decision-making.[83] When a team has the ball, it is given four plays, or "downs," to advance ten yards, after which it is given four more downs. If the team fails, it relinquishes the ball to the opponent at the spot where it failed. If it does not believe it can advance whatever is remaining of the ten yards on the last down, it can opt to punt the ball away to the opponent, forcing the opponent to start from an inferior position. It can also opt to kick a field goal (kicking the ball through the goalposts behind the end zone for three points). Punting and kicking are considered safer strategies than "going for it" (attempting to gain four more downs by advancing).

Using dynamic scoring, a method typically employed to predict the impact of economic policies, Romer examined all fourth-down situations by NFL teams from 2009 to 2011 in the first three quarters of games. Based on the "expected points" concept by Carter, he found that

---

82. Matich, interview.

83. David Romer, "Do Firms Maximize? Evidence from Professional Football," *Journal of Political Economy* 114, no. 2 (2006): 340–65, doi:10.1086/501171.

coaches took the safer route far more frequently than optimal. Of the 1,068 times it was optimal for the team to "go for it," coaches did so only 109 times.[84]

One can infer whether Mendenhall was aware of this widely known finding by examining his fourth-down behavior. Romer did not provide the optimal strategy for every situation on the field, against which to compare Mendenhall's decisions. Fortunately, a similar study by Burke and Quealy did.[85] They employed the same methodology as Romer, except with more data. Play-by-play data for Mendenhall's games are available from ESPN.com and BYUCougars.com. Mendenhall faced 306 fourth-down situations in the first three quarters of games, with 15 or fewer yards to go to convert, in which it is optimal to "go for it." As seen on table 5, he "went for it" 102 times, a frequency of exactly one-third. I use a two-sample proportion test to determine whether his percentage was higher than that of NFL coaches. It was, with high certainty ($p < 0.0001$). To examine whether Mendenhall was operating optimally less than all the time, I use the exact binomial test, designed to determine whether observations are different from a theoretical expectation. His percentage was far less than 100 percent ($p < 0.0001$). So while he was subject to risk aversion like any other coach, he acted optimally over three times more frequently than the average NFL coach, indicating awareness of Romer's study and the adoption of in-game tactical analysis.

Table 5. Comparative Fourth-Down Decision-Making

	Situations in which "Going for it" on Fourth Down is Optimal	Times the Coach "Went for It" in Those Situations	Frequency
NFL Coaches 2009–11	1068	109	10.2%
Mendenhall 2005–15	306	102	33.3%

Icing the Kicker

Another indicator of how intensely Mendenhall applied analytics is in his engaging in a practice known as "icing the kicker." Before the opposing team kicks a field goal (FG), coaches often call a time out or two to

84. Romer, "Do Firms Maximize?" 354.

85. Brian Burke and Kevin Quealy, "How Coaches and the NYT Fourth-Down Bot Compare," *New York Times,* November 28, 2013, http://www.nytimes.com/newsgraphics/2013/11/28/fourth-downs/post.html.

inflict anxiety on the kicker by forcing him to contemplate his upcoming kick, in hopes that this will decrease the probability the kicker converts the FG. Mendenhall stirred controversy in the 2014 bowl game, when he consumed his two remaining timeouts to do this when opponent University of Memphis was facing a point-after-touchdown (PAT) attempt, which was considered a "chip shot" that succeeded with little variation.

To examine whether icing works, Berry and Wood collected data on all 2003 NFL FG attempts from 2002–3 for a logistic regression with physical and psychological variables surrounding the kicker, including whether the kicker was iced.[86] In a logistic regression, the dependent variable is binary—in this case, 1 if the kick was made, 0 if not. The study found that icing lowered the likelihood of success by 46.5 percent ($p = 0.03$).[87] Before concluding that Mendenhall's act is consistent with analytics, two things require consideration. First, when the authors decomposed the data by kick length, they found that "icing" had the largest impact among FGs from 31 to 50 yards. For FGs thirty yards and under, there were only five iced attempts recorded and four of them were made. Since a PAT equates to a FG of 20 yards, it belongs in this category, so nothing can be said about Mendenhall's decision to ice a PAT attempt. The sample size for short FGs was simply too small.

Second, the sample size of the entire study was questioned. Moskowitz and Wertheim noticed that Berry and Wood's dataset contained only thirty-eight incidences in which the kicker was iced, and followed up by extending the data from 2001 to 2009.[88] They found that icing made no statistically significant difference. The bulk of the evidence suggests that icing does not work, so Mendenhall's decision to ice indicated he is not aware of these studies.

Overall, Mendenhall's attitude and actions in regard to points, execution, penalties, player development, fourth-down decisions, and "icing," demonstrated that, although not "all-in," he incorporated analytics in his decision-making to a substantial degree. He acted more optimally than the average NFL coach, adopted sophisticated player-tracking technology, and harbored a counterintuitive yet justifiable attitude toward

---

86. Scott M. Berry and Craig Wood, "The Cold-Foot Effect," *Chance* 17, no. 4 (2004): 47–51, doi:10.1080/09332480.2004.10554926.

87. Berry and Wood, "Cold-Foot Effect," 51.

88. Tobias J. Moskowitz and L. Jon Wertheim, *Scorecasting: The Hidden Influences behind How Sports Are Played and Games Are Won* (New York: Crown Archetype, 2012), 213–14.

penalties. Mendenhall's record, combined with a player's involvement in analytics, show that the program did not let the analytics revolution pass by unnoticed during his tenure.

BYU Football Responds to the Revolution II: New Staff and Analytics

Mendenhall's departure means it is also important to examine the value the incoming staff has accorded analytics. Clues from the short duration the regime has been in place indicate that receptiveness varies among high-level individual coaches. Sitake appears open-minded about analytics, while the views of new offensive coordinator Ty Detmer are unknown.

Advanced Player Metrics

Sitake's periodic meetings with Zachary Knowlton, a BYU graduate student in statistics, furnish evidence that Sitake welcomed analytics. Knowlton reported that Sitake was "really, really open to what we can do to help," and that he helped Sitake "relate player production to points."[89] Novel statistics for translating performances into points are among the innovations of the analytics revolution. Bill James broke ground in 1979 with a simple but powerfully predictive *runs created* formula equating runs to the outcomes batters produce, namely hits, singles, doubles, triples, home runs, walks, and hits-by-pitch.[90]

With *runs created,* James determined the impact of those outcomes intuitively. Lindsey constructed a more precise formula based on how much the batter changed the expected number of runs with those

89. Zachary Knowlton, interview by Spencer Linton and Jason Shepherd, *BYU Sports Nation,* BYUTV, April 27, 2016, available on *Youtube,* https://www.youtube.com/watch?v=R5Ck2uQPLDM. Knowlton completed his master's degree in April 2016 and is no longer involved in BYU sports analytics.

90. Wayne L. Winston, *Mathletics: How Gamblers, Managers, and Sports Enthusiasts Use Mathematics in Baseball, Basketball, and Football* (Princeton, N.J.: Princeton University Press, 2009), 11–12. Points are called "runs" in baseball because players run through three "bases" in a diamond-shaped path to score. A validation study showed teams' *runs created* predicted run scoring within 14.6 percent, compared to 31.7 percent for the traditional metric of batting average. See Jim Albert and Jay Bennett, *Curve Ball: Baseball, Statistics, and the Role of Chance in the Game* (New York: Springer-Verlag, 2001; 2003), 230.

outcomes.[91] To illustrate: A player goes to bat with a runner on first base and one out. In that situation, teams score an average of 0.498 runs before the end of the half-inning.[92] If he hits a single and the runner moves to third base, there are now runners on first and third bases with one out. In this new state, teams score an expected 1.115 more runs by the half-inning's end. The batter contributed 1.115 – 0.498 = 0.617 runs by hitting that single. Note Lindsey could measure a player's contribution to scoring without anyone's having scored. Thereby outcomes of every play have scoring values attached, even those where no scoring occurred.

White and Berry did likewise for the NFL by calculating the expected points scored from every scenario on the field and deriving a player's value from how much his action changed those points.[93] To explain, the authors provided this illustrative scenario: Teams with the ball on third down with five yards remaining from converting a first down at ten yards from the end zone score 3.9 expected points, that is, an average of 3.9 points. If the QB throws a touchdown pass from that spot for 7 points, he contributes 7 – 3.9 = 3.1 points.[94] If the opponent intercepts the throw and scores a touchdown, the QB contributes (–7) – 3.9 = –10.9 points.

To compute the expected points used above, White and Berry ran a polychotomous regression, which allows for a finite number of discrete dependent variable values and thereby fits the seven discrete scoring outcomes in football: touchdowns, FGs and safeties scored and allowed, and no scoring. Their respective points are {7, –7, 3, –3, 2, –2, 0}. They set yards from the goal line and yards remaining to convert a first down as continuous variables and second, third, and fourth downs as binary variables (with first down as the baseline) that explain the seven outcomes. Expected points from a particular down-distance-position state equal the aggregate impact on scoring of down, distance from converting back to first down, and field position of that state.

---

91. George R. Lindsey, "An Investigation of Strategies in Baseball," *Operations Research* 11, no. 4 (1963): 477–501, doi:10.1287/opre.11.4.477.

92. Lindsey, "Investigation of Strategies," 485.

93. Chris White and Scott Berry, "Tiered Polychotomous Regression: Ranking NFL Quarterbacks," *American Statistician* 56, no. 1 (2002): 10–21, doi:10.1198/000313002753631312.

94. White and Berry, "Tiered Polychotomous Regression," 11.

Knowlton and Fellingham replicated White and Berry's work on NCAA data, also using a polychotomous regression.[95] Then Knowlton presented this work to Mendenhall,[96] and later to Sitake,[97] integrating it with grades the coaches gave players on tasks he assigned them. Coaches give each player a plus-minus grade for tasks on each play (for instance, block opposing player *x*). Knowlton provided Sitake measures of player contributions from performing said tasks through how much they changed expected points. As with Lindsey, and White and Berry before him, Knowlton was able to attach point values to player performances "whether or not they score a touchdown."[98] While nothing is known about Mendenhall's receptiveness, Sitake's staff "really liked it."[99]

Implementation of Analytic Practices

In addition to openness to analytics, Sitake's working relationship with Knowlton appeared to follow analytic best practices. Alamar, who has advised National Basketball Association and NFL teams, asserted that for analytics to be successful, there needs to be acknowledgement that (1) "rarely will the analyst understand the sport as deeply as the top decision makers," and (2) "decision makers need to ask questions based on their deep knowledge of the sport with the goal of gaining some additional insight into the sport in general or about a specific player or team."[100] Furthermore, when analysts wish decision makers adopt a new metric, they must "provide the proper evidence and context for the new metric in order to demonstrate its value to the decision makers."[101]

Knowlton's following description indicates that his collaboration with Sitake follows Alamar's model: "What we do is . . . provide another resource for the coaches. They know what they're doing. But if they have another resource, they can quantify that information; we want to provide that resource."[102] Knowlton elsewhere acknowledged his supplementary role to the more knowledgeable coach: "A coach will

95. Zachary Knowlton and Gilbert Fellingham, "Ranking NCAA Football Teams through Expected Points," paper presented at the 2015 Joint Statistical Meeting of the American Statistical Association, Seattle, Wash., August 8–13, 2015.

96. Hellewell, "Statistics MVP."

97. Knowlton, interview.

98. Quoted in Hellewell, "Statistics MVP."

99. Knowlton, interview.

100. Alamar, *Sports Analytics,* 46.

101. Alamar, *Sports Analytics,* 71.

102. Knowlton, interview.

have a coach's eye. They've been playing football forever; they'll know who played well or not that game."[103] Additionally, in lock-step with Alamar's model, Knowlton reported having Sitake ask the research questions: "[Sitake] wants to move it toward scouting, as well as toward that self-scouting, self-evaluation."[104] Knowlton also reported that when he presented Sitake with a game-by-game report of the 2015 season, Sitake replied, "This makes a lot of sense," indicating that Knowlton effectively demonstrated the value of new metrics in the report.[105] Based on Knowlton's description, Sitake and Knowlton followed Alamar's blueprint for analytic success.

Offensive Scheme

While Sitake expressed enthusiasm for new statistics and analytic practices, Detmer sent a murkier signal. In his introductory press conference, Detmer fielded the following question from Utah radio personality Greg Wrubell: "Are you into analytics at all? And what do you think are going to be the most important offensive indicators to you?" Detmer responded, "I haven't been a big analytical guy."[106] He proceeded to list basic statistics: turnovers, penalties, first downs, and red-zone scoring, as metrics to which he would pay attention. "Football's football at the end of the day," he said, exhibiting a traditionalist mindset.

Detmer focused on traditional statistics, while Sitake took more advanced statistics like expected points to heart. Detmer did not outright reject analytics but merely expressed that he had not kept current. Moreover, he is widely known for his prodigious football mind and may flourish without their application. Similarly, Baumer and Zimbalist noted that the Atlanta Braves, who won fourteen consecutive division titles, five league titles, and a World Series Championship under GM Schuerholz, "were not known for embracing the Sabermetric philosophy, [but] the intelligence of their front office personnel was impressive."[107] Detmer's intelligence with in-game schematics will likely matter more than any use of analytics.

---

103. Quoted in Hellewell, "Statistics MVP."

104. Knowlton, interview.

105. Knowlton, interview.

106. Quoted in Brandon Despain, "Football—Ty Detmer Press Conference" (Press Conference, January 5, 2016), *The Official Home of the BYU Cougars,* http://byucougars.com/video/m-football/football-ty-detmer-press-conference.

107. Baumer and Zimbalist, *Sabermetric Revolution*, 129.

That said, tension might arise between analytics and Detmer's *modus operandi.* For instance, the QB can receive the snap from the center to begin the play via two means, by hand or from a distance. The latter is known as the "shotgun" because from five or more yards behind the line of scrimmage the quarterback can spray the ball around more easily to various receivers. A study of 2006 NFL data showed that teams advanced, on average, five yards per play when the QB received the snap by hand, and 6.4 yards from shotgun.[108] In the same press conference, Detmer said that he would have the QB take the snap by hand more, which empirics seem to indicate would result in fewer yards advanced. By stating he "would like to see more use of the tight end," he gave all indications of returning BYU's offense to one similar to those of his days as a QB, an offense in which he took virtually every snap by hand.[109] But this tension should not hinder the program. As stated earlier, analytics should play a supplementary role to more knowledgeable decision makers, and few are more knowledgeable than Detmer.[110]

Davenport argued that football lagged behind baseball and basketball in analytics usage, due to (1) the complex interaction of twenty-two players on the field, (2) the difficulty in rating performance of players on each play, and (3) the conservative football coaching culture.[111] Reason 1 owes to the nature of the sport and is immutable. The staff has mitigated reason 2 by adopting a system of translating performance into points. Detmer's sustained NFL career as a "player-coach" is a possible explanation why reason 3 may be present within the program.[112]

If football's lack of analytic intensity makes it lag behind other sports, it also makes the BYU football program's analytic intensity more advanced relative to the rest of football. Take Mendenhall's fourth-down

---

108. Mike Tanier, "Gunner Gruden," in *Pro Football Prospectus 2007*, ed. Aaron Schatz (New York: Plume, 2007), 277–79.

109. Quoted in Despain, "Ty Detmer Press Conference." The tight end splits time between blocking and catching.

110. Steve Young ranked Detmer behind only Joe Montana among players with the best football intuition he had encountered in his illustrious NFL career. See Steve Young, interview by Spencer Linton and Jarom Jordan, *BYU Sports Nation,* BYUTV, January 8, 2016, available on *Youtube,* https://www.youtube.com/watch?v=JLwsUP6FHlU.

111. Davenport, *Analytics in Sports,* 6.

112. The description "player-coach" comes from Blaine Fowler. See Blaine Fowler, interview by Spencer Linton and Brian Logan, *BYU Sports Nation,* BYUTV, June 29, 2016, available on *Youtube,* https://www.youtube.com/watch?v=Nzh48GayODU.

behavior, for example. Although he "went for it" only a third of the time it was advantageous for him to do so, it was still three times more frequently than NFL coaches did. BYU uses biometric data to maximize player endurance and has engaged at least one player in analytics, two practices Davenport deemed to be at the frontier. Mendenhall emphasized points scored and allowed, but Sitake went one step further and adopted advanced metrics that determine how much each play contributes to those totals. There are no signs of BYU using motion-capture data, of gathering proprietary data, or of centralizing all its data into information systems for decision-making. The program does not appear to have any staff devoted to analytics aside from a consultant. BYU sits at the frontier of the revolution in some ways, but not all.

Conclusion

This article explored three main ideas from new analytic thought of import to the program: objective tools for evaluating teams, the importance of a long-ignored position, and factors affecting recruiting. Advanced statistics enable us to cut through much of the noise and inform questions. While Mendenhall may have polarized fans, we now know that his performance level was not lower than that of Edwards, unless we grant Edwards a three-year grace period. However, it is the position of this article that that grace period is preferred.

We also know that much of the best LDS talent is stocked at the two most important positions. BYU's ability to acquire elite players at the most important position, QB, has remained steady, while much potential remains untapped at personnel to protect the QB and rush opposing QBs. Current coaching changes may help the program realize that potential, but I believe the program should consider taking action to lock in its ability to recruit OLs and DLs, an action less contingent on the sitting staff. Lack of power-conference membership and fewer NFL prospects have frustrated some fans; analytics confirmed the importance of the former to recruiting but complicated the latter by challenging the notion that a school's NFL placement abilities weigh heavily on a recruit's college decision. This finding, though robust (it received confirmation from two different studies), does not overturn the consensus among college football coaches that NFL aspirations drive a college recruit's decision.[113]

---

113. More likely, to gauge how much a school helps potential recruits' chances to play professionally, recruits use a school's P5 status instead of tracking how many NFL players the program produces. As then–Notre Dame head

Analytics have shed light on the program and have also made their way into the program's decision-making. At the dawn of a new intellectual era in sports, BYU's outgoing and incoming staffs have embraced analytics to a substantial degree. Mendenhall has left no doubt about his awareness of at least some developments in analytics. Although he has engaged in some not-so-analytic behavior, like icing the kicker, he appears overall to be ahead of most of his profession regarding statistics.

The new staff's receptiveness to analytics depends on personnel. Sitake has embraced an innovative way of relating the results of each football play to points scored. Knowing how much each completed task is worth would enable him to value plays and players more accurately and gain a competitive advantage. The nature of his working relationship with a statistician also demonstrates proper execution of analytic practices.[114]

Detmer has apparently not stayed abreast of analytic findings. Although I identified possible tensions between analytic thought and his own thinking, I do not anticipate this to be problematic. Analytics should play a supplementary, not substitutionary role to his distinguished football intuition.

Based on this assessment, the program is at a more advanced than average position overall with regards to analytics, though many opportunities remain unexplored.[115] While this article includes only a sampling of new analytic ideas, its primary motivation is to begin a conversation and engage the passionate numerati (quantitatively oriented fans) to consecrate their skills to creating independent resources that will identify possible advantages for the program and assist in bringing positive publicity to BYU and its sponsoring church.

---

coach Charlie Weis said in his introductory press conference, "When players [are] going to college, when they go to *front-line programs*, they want to be able to play on Sundays. They want to play on Saturdays, so that they could end up playing on Sundays." "Notre Dame Head Coach Charlie Weis Teleconference Transcript" (Press Conference, December 13, 2004), *ND,* http://www.und.com/sports/m-footbl/spec-rel/121304aaa.html; emphasis added. "Playing on Sundays" alludes to NFL games, "playing on Saturdays" to college games.

114. Reports from BYU's sports analytics group late in the publication process indicate that Sitake suspended his meetings with the group when the 2016 season started. The relationship between the program and analytics remains in flux.

115. This is changing rapidly even as this article heads to the press. See Sharon Katz, "College Football's Analytics Revolution Is Just Beginning," *ESPN,* September 30, 2016, http://www.espn.com/college-football/story/_/id/17677192/college-football-analytics-revolution-just-beginning.

Appendix A: Data Sources

BYU Historical Games Results (used in tables 1 and 2). *Massey Ratings.* Games can be downloaded from http://www.masseyratings.com/team.php?t=891&s=279541. Each game conveniently contains the opponent's final Massey rank on the same row.

Draft Data. *Cougarstats.* Players are listed on http://sltrib.cougarstats.com/draft.php.

Recruiting Data (used in tables 3 and 4). *Scout.* This information can be downloaded from http://www.scout.com/college/byu/2015-football-commits. Scout.com profiles for each player identify whether players are LDS. Polynesians identified but not by name on that list are Jake Kuresa and Kyle Van Noy.

NCAA Run/Pass Frequencies. *ESPN.* Rushing: http://espn.go.com/college-football/statistics/team/_/stat/rushing. Passing: http://espn.go.com/college-football/statistics/team/_/stat/passing.

NFL Run/Pass Frequencies. *ESPN.* Rushing: http://espn.go.com/nfl/statistics/player/_/stat/rushing. Passing: http://espn.go.com/nfl/statistics/player/_/stat/passing.

BYU Play-by-Play Data (used in table 5). *ESPN/BYU Athletics.* Downloaded from http://espn.go.com/college-football/team/schedule/_/id/252/year/2015/byu-cougars. I derived Mendenhall's fourth-down decisions from this data. For some reason, the 2006 and 2007 Tulsa games had play-by-play data missing. Fortunately, they can be accessed here: http://byucougars.com/m-football/event/2006/tulsa and here: http://byucougars.com/m-football/event/2007/tulsa.

Table 6. EGLS-AR(1), Impact on Margin-of-Victory, Grace Periods for LaVell Edwards

Variable	1 (1973–2015) n = 541	2 (1974–2015) n = 530	3 (1975–2015) n = 518	4 1976–2015 n = 507
INTERCEPT	–3.466628	–3.071090*	–2.901024**	–2.476015#
OPP_MASSEY_RANK	0.206912****	0.205205****	0.207504****	0.208183****
HOME	3.195950****	3.174340****	3.172963****	3.203545****
COACHCROWTON	–10.207137**	–10.482544***	–10.811242***	–11.286931**
COACHMENDENHALL	–3.184314#	–3.438003#	–3.798108*	–4.281655*
ε_{g-1}	0.1480461*	0.151083*	0.146773*	0.134985*
Pseudo-R^2	0.366	0.362	0.365	0.368
% Games Predicted	0.767	0.781	0.789	0.784

#p < .10; *p < .05; **p < .01; ***p < .001; ****p < .0001.

Table 7. EGLS-AR(1), Impact on Margin-of-Victory, Equal Grace Periods for Edwards and Mendenhall

Variable	1 n = 529	2 n = 505	3 n = 480	4 n = 456
INTERCEPT	–3.265624**	–2.978307*	–2.863863*	–2.399087
OPP_MASSEY_RANK	0.204203****	0.203986 ****	0.207046****	0.207197****
HOME	3.180235****	3.075122***	2.966057****	2.717105****
COACHCROWTON	–10.221500**	–10.505347 **	–10.834492***	–11.320090***
COACHMENDENHALL	–2.939799	–3.438003*	–5.431897*	–6.381887*
ε_{g-1}	0.1474258*	0.1389885*	0.1357471*	0.1235686*
Pseudo-R^2	0.360	0.358	0.363	0.365
% Games Predicted	0.777	0.778	0.775	0.763

#p < .10; *p < .05; **p < .01; ***p < .001; ****p < .0001.

Appendix C: Limitations to Study

The BYU football staff and its statistical consultants have undoubtedly used more metrics than what outsiders can discern. Furthermore, recruiting rankings are determined by scouts and are subjective. Finally, statistical analysis is no substitute for the immeasurables of a good coach, quarterback, or left tackle.

Nelson Chung is a GS-11 Mathematical Statistician for the U.S. Census Bureau's Center for Disclosure Avoidance Research. He holds an BA from Brigham Young University in economics and political science, and an MS from Johns Hopkins University in applied mathematics. The Census Bureau did not provide monetary or in-kind funding for this article.