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What if statisticians ran college football? A re-conceptualization of the football bowl subdivision

Abstract: Conference affiliation is an important consideration for institutions of higher learning, both athletically and academically. Traditionally, conference affiliation in the NCAA has been determined based largely on geography. However, recent events beg the question of what would be the result if conference affiliation, and classifications such as being a Bowl Championship Series Automatic Qualifier, were re-configured based not on traditional aspects of geography, tradition and like-mindedness, but solely on the financial and on-field performance of an institution's football program. This paper utilizes a multivariate statistical technique (cluster analysis) to re-conceptualize conference affiliation, as well as the current Football Bowl Subdivision (FBS) hierarchy, based solely on data reflecting the performance of each FBS institution's football programs. The analysis results in a total of 23 programs being relegated from their current status, while several programs (such as Boise State, Louisville and Rutgers) have been promoted into the highest tier of the FBS based on their performance. The paper also presents a new clustering of four "super" conferences based on this same performance data, resulting in four conferences consisting of programs with similar on-field and financial performance over the past 10 seasons.

Keywords: cluster analysis; college football; conference affiliation; financial performance.

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1 Introduction

In the coming years, seismic changes may be forthcoming to the structure of major college football. Recently, several powerbrokers in the intercollegiate athletics industry have suggested that the top five athletic conferences would

benefit from a re-conceptualization of the current NCAA (National Collegiate Athletic Association) Football Bowl Subdivision (FBS) hierarchy (Baumgardner 2013; Glier 2013). The hypothetical new structure in college football features a so-called "Division IV" consisting of the institutions belonging to the five "power" intercollegiate athletic conferences (the Atlantic Coast Conference, Big 12 Conference, Big Ten Conference, Pac-12 Conference, and Southeastern Conference). This new division would be separate from the current NCAA-governed structure and have the ability to make its own rules and regulations (Baumgardner 2013). "Division IV concepts are out there," noted Big Ten Conference Commissioner Jim Delany, explaining that other Division I schools can restrain programs in these conferences "competitively" via the NCAA legislative process (Dodd 2013). An initial step involved the circulation of a 14-page proposal by the president of the NCAA Division I Board of Directors in January of 2014. The proposal called for a variety of changes in the NCAA's governance structure, many of which would provide the members of the "power" conferences more autonomy, such as a new, simplified Division I board (Wolverton 2014).

Conference affiliation has always been an important consideration for institutions of higher learning, both athletically and academically (Sweitzer 2009; Groza 2010). Traditionally, conference affiliation in the NCAA was determined largely based on geography. For example, when the Big Ten Conference (originally named the "Western Conference") was initially formed in 1896, its founding institutions were located in the neighboring States of Illinois, Indiana, Michigan, Minnesota and Wisconsin (Big Ten Conference n.d.). Similarly, when the Athletic Association of Western Universities (now known as the Pac-12 Conference) was formed in 1959, all of its institutions were located in the States of California and Washington (Gall 2012a).

Institutions affiliated by conference do share other similarities besides geographical concerns. For example, the institutions in the Big Ten share membership in the Committee on Institutional Cooperation (CIC n.d.). The CIC assists the institutions in advancing their academic missions, generating unique opportunities for students and faculty, and serving the common good by sharing expertise, leveraging campus resources, and collaborating on innovative programs (CIC n.d.). All but one member of the Big Ten (the

University of Nebraska) are also members of the American Association of Universities (AAU), a nonprofit association of 62 preeminent research universities (AAU n.d.).

However, significant advances in transportation and technology since the time conferences were originally formed make geography far less important for matters of institutional cooperation and affiliation. Recent events have illustrated that fact. For example, the institutions who most recently agreed to join the Big Ten Conference, the University of Maryland and Rutgers University, are more than 800 miles from Western-most members Iowa, Minnesota and Nebraska. The most recent institutions to join the Pac-12 Conference, the University of Colorado and the University of Utah, are more than 700 miles from the Conference's traditional West Coast base. In 2012, West Virginia University joined the Big 12 Conference. West Virginia does not share a border with any other conference member and is 875 miles from the closest Big 12 Conference institution (Iowa State). For a time, San Diego State University and Boise State University had decided to join the Big East (now American Athletic) Conference. The two institutions, which would have been located more than 2000 (San Diego State) and 1600 miles (Boise State) from their closest fellow members, later reconsidered and decided to stay in the Mountain West Conference (Gall 2012b).

1.1 Purpose

Many have argued that these and other recent decisions related to conference affiliation were motivated solely by the interests of the institutions' football programs, and a quest to improve upon each school's on-field and financial performance. These events beg the question of what would be the result if conference affiliation, and classifications such as membership in the proposed Division IV or status as a BCS Automatic Qualifier, were re-configured based not on traditional aspects of geography, tradition and like-mindedness, but solely on the actual performance of an institution's football program. The proposed Division IV assumes that every member of the so-called "power" conferences deserves to be placed in this new division. What if placement in the hypothetical Division IV was based solely on merit, or on analytics reflecting the program's performance? Would all of the institutions in these conferences deserve receive such status, based on their performance? Are there any institutions outside the five "power" conferences which deserve this status based on their performance? Therefore, the purpose of this paper is to utilize a multivariate data analysis technique (cluster analysis) to re-conceptualize conference affiliation, as

well as the institutions that deserve to be placed in the new proposed Division IV, based solely on the relative performance of each institution's football program.

The first study is designed to re-conceptualize the current BCS AQ and non-AQ hierarchy by re-classifying the institutions that deserve to be placed in Division IV based not upon their conference affiliation, but on their financial and on-field performance. Similar to the concept of relegation in European soccer (Barros and Leach 2006), we employed techniques to "relegate" institutions which, based upon analytics, do not deserve to be grouped among the other BCS AQ "power" conference programs. As explained by Kuper and Szymanski (2012) in their book *Soccernomics*, "In every soccer league in Europe, the bottom few teams are 'relegated' at the end of the season to a lower tier ... It's as if the cellar teams in Major League Baseball got exiled to Triple A" (Kuper and Szymanski 2012, 199). At the start of the 2012 college football season, all 120 institutions in the NCAA FBS were classified into two groups: automatic qualifiers (AQ) or non-automatic qualifiers (Non-AQ). Being designated an AQ institution means in effect that winning one's conference provides automatic entry into the Bowl Championship Series (Adelsen 2012). If an institution is not classified as AQ, there are other qualifications that the institution must meet in order to receive entry into the BCS (e.g., finishing among the top 16 in the final BCS standings). Under the current BCS guidelines, the only requirement to be an AQ institution is membership in an AQ designated conference. Similarly, the only requirement for membership in the proposed Division IV is that an institution is a member of one of the five "power" conferences.

Some have also argued for the inevitability of the eventual formation of four 16-team "super" conferences, which will house all of the most successful football programs (Whiteside 2011; Arguello 2012). Recent events, such as the migration of several institutions (e.g., Syracuse, Pittsburgh and Louisville) from the former Big East Conference to the Atlantic Coast Conference (ACC) and Rutgers' move from the former Big East to the Big Ten, seem to suggest the possibility (Gall 2012c). Therefore, we also utilized this same technique to develop a new "super" conference structure for the NCAA FBS.

Though this paper's exercise is conceptual in nature, statisticians and economists would argue that clustering football programs based on analytics reflecting performance rather than antiquated notions such as tradition or geography would likely result in increased competitive balance, as the programs would be grouped with more similar programs. This would result in increased uncertainty of outcome, which should theoretically increase

demand, leading to higher attendance, television ratings, and ultimately increased revenues (Fort and Quirk 1999; Quirk 2004; Rein, Kotler and Shields 2006; Dittmore and Crow 2010). Given this, demonstrating new ways in which to increase competitive balance is an important consideration in college football. Though purely a conceptual exercise, this study's findings reveal important insights about the performance of various NCAA FBS football programs and may be intriguing for those working and interested in intercollegiate athletics. Practical implications for the approaches utilized in this paper include their use in creating conference divisions and for the evaluation of the programs by the new College Football Playoff selection committee.

1.2 Literature review

Most of the existing research on intercollegiate athletic conferences has done so under the context of examining the competitive balance within the conference (Depken and Wilson 2004; Rhoads 2004; Quirk 2004; Perline and Stoldt 2007; Dittmore and Crow 2010). Others have studied demand for individual institutions in conferences by examining changes in attendance based upon a variety of factors (Price and Sen 2003; Groza 2010).

A number of studies have utilized variables related to an institution's on-field success to estimate demand for the school's football team. Among the variables utilized include the number of years a school has fielded a team (Price and Sen 2003), number of bowl appearances (Price and Sen 2003; Groza 2010), historical winning percentage (Kaempfer and Pacey 1986), and Sagarin computer rating (Groza 2010). Variables not directly related to a team's on-field performance that have been utilized in the literature to reflect demand for a program include average attendance (Groza 2010), stadium capacity (Price and Sen 2003), percent of stadium capacity (Fizel and Bennett 1989; Groza 2010), and school enrollment (DeSchraver and Jensen 2002).

2 Method

The focus of this paper is to re-classify institutions based upon their actual performance, rather than the usual classifications of tradition and geography. Therefore, rather than variables that have been utilized in the literature to operationalize an institution's tradition or long-term success (such as number of all-time wins, total bowl appearances or historical winning percentage), variables

that better represent an institution's more recent success were utilized. An institution's on-field success was reflected by compiling each institution's total number of wins, losses and winning percentage in football over the past 10 seasons. The highest number of wins over the 10-year period from 2003 to 2012 was owned by Boise State University (117), who also boast the top winning percentage for the period (.893). The least successful program over the past 10 years was New Mexico State, with a winning percentage of .238 and 29 wins. Both Eastern Michigan University and Duke University also had 29 wins during the period. The mean number of wins over the period was 66 ($\sigma=20$), while the mean number of losses was 59 ($\sigma=17$). The mean winning percentage was .525 ($\sigma=.146$), given that FBS institutions also play a number of contests against FCS (Football Championship Subdivision) institutions. Unlike professional leagues that feature balanced schedules, the teams that FBS football programs play varies widely (Groza 2010). Therefore, we also compiled a measure of on-field performance that takes into account a program's strength of schedule. Following the approach recommended by Groza (2010), each program's end-of-season Sagarin computer rating was compiled and the number of Sagarin points earned over the 10-year period was totaled. Sagarin ratings are an objective computer-based rating compiled by noted statistician Jeff Sagarin and published by *USA Today* (Groza 2010).

Recent demand for each program was estimated by compiling each institution's average attendance and percent capacity for the institution's home stadium during the 2012 football season. As stated in the literature review, these attendance measures have been utilized throughout the literature to estimate demand for an institution's college football program (e.g., Fizel and Bennett 1989; Groza 2010). Utilizing the percent capacity variable helps to reward programs that may have smaller stadiums (i.e., less tradition), yet are still in high demand and therefore fill their stadium to capacity. Average attendance was utilized rather than total attendance, given that some institutions play more home games than others. The top institution in average attendance in 2012 was the University of Michigan, with an average attendance of 112,252. The Ohio State University led in total attendance with 842,637, due to the fact that they played eight home games at Ohio Stadium in 2012 (illustrating the value of utilizing average attendance rather than total attendance).

Few studies have empirically examined the financial performance of NCAA intercollegiate football programs. The variables that the authors of this paper compiled in order to re-classify the institutions based on financial performance included each institution's revenues from

football and expenses spent on football over the past 10 years. The information was provided by each institution to the Department of Education (DOE) as a result of the Equity in Athletics Disclosure Act (U.S. Department of Education 2009). The act requires co-educational institutions of postsecondary education that participate in a federal student financial assistance program and have an intercollegiate athletic program to prepare an annual report to the DOE on athletic participation, staffing, and revenues and expenses by men's and women's teams (U.S. Department of Education 2013). The most recent financial information included in the DOE Equity in Athletics database was from the 2011 to 2012 academic year ending June 30, 2012. Thus, the first year of revenues and expenses included are from the 2002 to 2003 football season. Compiling data over a total of 10 years helps to better operationalize each institution's financial performance over a longer period of time, as well as help to control for any unusual year-over-year changes in the data (such as buyouts for coaches and unusually large donations).

Revenue attributed to each institution's football program include monies earned from appearance guarantees and options, contributions from alumni and others, institutional royalties, signage and other sponsorships, sport camps, state or other government support, student activity fees, ticket and luxury box sales, and any other revenues attributable to the football program (US DOE 2013). Revenue data spanned from a high of \$723.24 million for the University of Texas to a low of \$25.71 million for the University of Louisiana-Monroe (μ =\$187.01 million; σ =\$160.15 million).

Expenses included guarantees and options, athletically related student aid, contract services, equipment, fundraising activities, operating expenses, promotional activities, recruiting expenses, salaries and benefits, supplies, travel, and any other expenses attributable to the football program. Recruiting activities included, but was not limited to, expenses for lodging, meals, telephone use,

and transportation (including vehicles used for recruiting purposes) for both recruits and personnel engaged in recruiting, other expenses for official and unofficial visits, and all other expenses related to recruiting (U.S. Department of Education 2013). Expense data spanned from a high of \$286.93 million for The Ohio State University to a low of \$26.04 million for Louisiana-Monroe (μ =\$108.45 million; σ =\$52.79 million). Table 1 features descriptive statistics for the variables compiled for this paper.

Of the 120 institutions in the NCAA FBS at the conclusion of the 2012–2013 academic year on June 30, 2013, there are six that were omitted from this analysis. Financial information for the athletic departments of the US Military Academy, the US Air Force Academy, and the US Naval Academy was not included in the DOE's Equity in Athletics database. There were also three institutions in the NCAA FBS that had not been for each of the past 10 years. Florida Atlantic University began play in FBS in 2004, Florida International University began in 2005, and the University of Massachusetts-Amherst began in 2012. Therefore, they were also omitted from this analysis in order to ensure the financial information for the FBS institutions is from a full 10 years in the FBS. As reflected in Table 1, data from a total of 114 NCAA FBS institutions were compiled for use in the analysis.

2.1 Cluster analysis

Cluster analysis (CA) is an exploratory data analysis tool for organizing observed data (e.g., people, things, events, brands, companies) into meaningful groups, or clusters, based on combinations of variables. CA is designed to maximize the similarity of cases within each cluster, while maximizing the dissimilarity between clusters (Burns and Burns 2009). Cluster analysis is frequently utilized to group companies based upon financial performance. For example, Afifi, Clark and May (2004) utilized CA to cluster

Table 1 Descriptive statistics.

	n	Minimum	Maximum	Mean	Std. Deviation
REVENUE	114	25714027	723246202	187012643.71	160152862.061
EXPENSES	114	26046195	286930063	108457988.56	52799990.096
WINS	114	29	117	66.03	20.227
LOSSES	114	14	93	58.77	16.866
WPCT	114	0.238	0.893	0.52484	0.145946
SAGARIN	114	532.43	907.88	712.5507	92.98913
AVGATT	114	3923	112252	44791.04	25699.729
PCTCAP	114	13.0	119.0	79.681	21.1047

companies from the chemical, health care and supermarket industries based on variables reflecting their financial performance, including sales, debt-equity ratio and price-to-earnings ratio. However, this is the first attempt in the literature to utilize CA to group NCAA FBS football programs based on their financial and on-field performance.

We began by ensuring that the data utilized to cluster the programs met the assumptions required by CA. Unlike a statistical inference technique whereby parameters from a sample are assessed as possibly being representative of a population, CA is an objective methodology for quantifying the structural characteristics for a set of observations (Grimm and Yarnold 2000). CA has strong mathematical properties, rather than a statistical foundation. Therefore, the assumptions that are important in many statistical tests, such as normality, linearity, homogeneity of variance, and multicollinearity, have little bearing on CA. For example, multicollinearity, which can pose significant issues in statistical techniques such as ordinary least squares (OLS) regression, is not an issue in CA (Grimm and Yarnold 2000). In CA, the only impact of the use of highly correlated variables is that they will be implicitly weighted more heavily. This will result in a weighting process that may not be apparent to the researcher but could impact the analysis. Therefore, we examined correlations between variables to determine if some variables are reflecting the same constructs.

As expected, the bivariate correlation between wins and winning percentage was nearly perfect (.992). Therefore, when performing the CA we needed to choose either wins or winning percentage in our analysis, as the correlation between the two variables suggested that both are representing the same construct (on-field performance) and including both variables in the analysis would be duplicative. Since the actual number of games played is different for each institution given the number of bowl games played, we utilized winning percentage to represent on-field success rather than wins in our analysis. The correlation between winning percentage and Sagarin computer rating was also high (.875), though not perfect. Therefore, we utilized the approach advocated by Groza (2010), who paired winning percentage with Sagarin ratings in his analysis in order to provide an overall measure of on-field performance that rewarded winning, while also taking into account strength of schedule. As explained by Groza (2010), this approach rewards programs with high winning percentages and weak schedules for their exemplary performance, while also rewarding programs with lower winning percentages that play strong schedules for their willingness to schedule strong programs.

It is well-known that many college football programs routinely spend all or nearly of their revenue, given that they are considered non-profit entities (Fort and Quirk 1999). Given that the goal of this analysis was to reward programs for their performance, we did not feel that simply out-spending others should implicitly be rewarded in this analysis. Therefore, programs were rewarded for their ability to generate revenue by utilizing revenue as the measure of financial performance in this analysis, rather than expenditures.

Finally, it is also recommended by those who utilize cluster analysis to standardize variables, particularly when the variables utilize differing scales. Given that the variables we have chosen to utilize have extremely different scales (i.e., winning percentage is on a scale from 0 to 1, while the scales for revenue and Sagarin ratings are much different), all variables were standardized prior to undertaking the cluster analysis.

2.2 Research design

Though there are several techniques that can be utilized to perform CA, most are placed into two main types: a hierarchical (or agglomerative) procedure and a nonhierarchical procedure (or K-means clustering; Grimm and Yarnold 2000). For this paper, there are several advantages to using a nonhierarchical procedure. First, in both Study 1 (the case of the Division IV institutions) and Study 2 (the formation of the four “super” conferences), the number of clusters that need to be formed has already been decided upon (i.e., 2 and 4, respectively). This feature is not possible in a hierarchical procedure. Second, as noted by Grimm and Yarnold (2000), hierarchical procedures tend to be misleading because undesirable early combinations of objects may persist throughout the analysis and lead to artificial or misleading results. Of particular concern are the effects of outliers in hierarchical procedures. The preferred method of dealing with outliers in a hierarchical procedure is to cluster analyze the data several times, deleting outliers at each step of the process. In the case of this paper, it is very possible that there may be one, and potentially many, outliers. This is another reason why in this case it makes sense to utilize a nonhierarchical procedure, as not only have they gained acceptability and are increasingly applied, but they are also much less susceptible to the effects of outliers.

As suggested by Afifi, Clark and May (2004), we began by plotting a scatter plot or diagram. Figure 1 is a scatter plot of the 114 NCAA FBS institutions based upon their standardized on-field (operationalized as

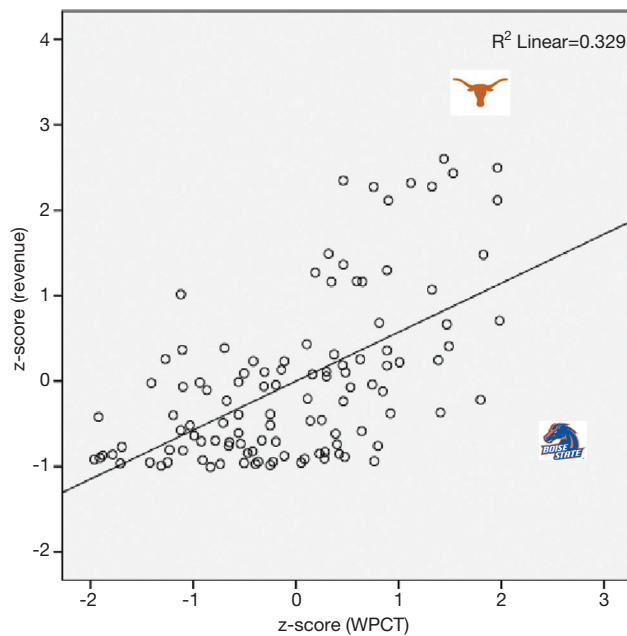


Figure 1 Scatter plot of z-scores for revenue and winning percentage for 114 NCAA FBS institutions.

winning percentage) and financial performance (total revenue) over the past 10 years, with on-field success on the horizontal axis and financial success on the vertical axis. The graph indicates a linear relationship between financial and on-field performance. These graphs often reveal the potential existence of outliers, which is one of the reasons why they are helpful. Figure 1 revealed one potential outlier based on financial performance (revenue), while another was based largely on winning percentage. These two institutions are indicated on the graph by their logos (Texas and Boise State). When CA is utilized to group the institutions, we will find out whether the statistical technique classifies these institutions as true outliers or not.

3 Study 1: Division IV membership

Now that we have ensured that no assumptions have been violated and analyzed the data utilizing graphical techniques, we are ready to cluster the institutions together based on the variables that have been compiled. As stated, Study 1 involved ascertaining which FBS institutions deserved membership in the new proposed Division IV, based on their actual performance (rather than conference membership) over the study's 10-year period (2003–2012). Utilizing CA to cluster FBS institutions based

on revenue, winning percentage, Sagarin rating, average attendance and percent capacity resulted in a total of only 45 of the 114 institutions being grouped together in the new Division IV. These 45 Division IV institutions had a mean revenue of \$323.23 million over the 10-year period (z -score=0.851), a mean winning percentage of 0.657 (z -score=0.908), an average of 806.81 total Sagarin points (z -score=1.014), average attendance of 69,232 (z -score=0.951) and on average filled their stadiums to 96.32% capacity (z -score=0.788). In contrast, the 69 FBS institutions that were not grouped in Division IV had a mean revenue of \$98.17 million (z -score=-0.555), a mean winning percentage of 0.438 (z -score=-0.592), an average of 651.07 Sagarin points (z -score=-0.661), average attendance of just 28,851 (z -score=-0.620) and filled their stadiums to just 68.83% capacity (z -score=-0.514) over the 10-year period. An analysis of variance (ANOVA) further revealed significant differences between the Division IV institutions and the rest of FBS based upon their revenue, $F(1, 112)=101.744$, $p<0.001$, winning percentage, $F(1, 112)=132.953$, $p<0.001$, Sagarin rating, $F(1, 112)=233.782$, $p<0.001$, average attendance, $F(1, 112)=164.600$, $p<0.001$, and percent capacity, $F(1, 112)=77.503$, $p<0.001$, at the $\alpha=0.05$ level. Figure 2 clearly depicts the differences between the institutions in the two groups based on the five variables.

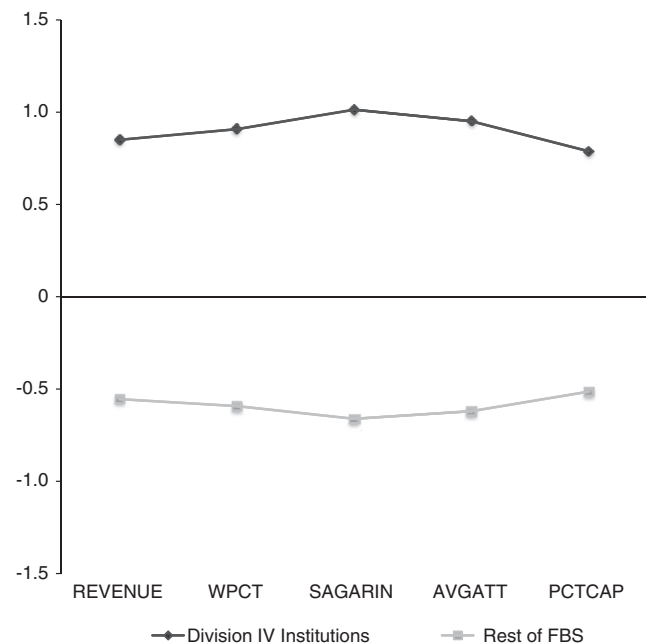


Figure 2 Profile diagram of means of standardized financial performance, on-field performance and attendance data for 45 FBS institutions in new Division IV and other 69 FBS institutions.

3.1 Discussion

Of particular interest to those who follow college football may be which programs were chosen by CA to be grouped in the new Division IV, as well as those who were not. Recall that the hypothetical Division IV was to be made up of the complete membership of the five “power” conferences. Based on the data analysis, a total of 23 FBS institutions were not deemed worthy of their membership in these conferences and in the new Division IV. These institutions have been in effect “relegated” from BCS AQ status to out of the new Division IV. Table 2 indicates these 23 institutions and denotes the Euclidian distance from the center of their cluster for each. Among the institutions not deemed worthy of their membership in a “power” conference based on performance (Table 2) are eight members of the ACC, five members of the Big Ten, three members of the Big 12, four members of the Pac-12, and three members of the SEC. Based on the Euclidian distances, it appears that Washington (2.199), Mississippi

State (1.971) and Iowa State (1.939) were the farthest away from the center (and thus closest to the institutions in Division IV), while Syracuse (0.805), Washington State (0.929) and Baylor (0.935) were closest to the center of their (non-Division IV) cluster.

Interestingly, there were also four institutions that were “promoted” from their conferences to membership in the new Division IV: Boise State, Louisville, Rutgers, and South Florida. In addition, two independents (BYU and Notre Dame) also earned inclusion. The financial, on-field, and attendance-related performance of these football programs indicates that they are more worthy of membership in the new division than many programs who are currently in the “power” conferences. Over the past 10 years, Boise State led all of FBS with a .893 winning percentage (winning 117 games), earned a total of 847.82 Sagarin points, and filled their stadium to 110.6% capacity, despite only earning \$91.93 million in revenue and averaging only 35,404 fans per game. Louisville, currently a member of the American Athletic Conference (AAC) and slated to move to the ACC in 2014, deserves membership in the proposed Division IV based on its .648 winning percentage (81-44 over past 10 years), 769.83 Sagarin rating points, \$167.47 million in revenue, average attendance of 49,991, and filling their stadium to 119% capacity. South Florida (also a member of the AAC) has gone 67-56 over the past 10 years (.545), earned 723.87 Sagarin points, managed \$86.43 million in revenue, filled their stadium to 106.5% capacity, and averaged 44,130 fans per game. Rutgers (a member of the AAC and moving to the Big Ten in 2014), was deemed worthy of membership in the Division IV based on its 74-51 record (a .592 winning percentage), 740.14 Sagarin rating points, \$148.96 million in revenue, average attendance of 49,188, and 91.8% capacity. Despite not being a member of a “power” conference, BYU has earned \$126.25 million in revenue, gone 83-43 (a .659 winning percentage), earned 780.71 Sagarin rating points, averaged 61,161 fans per game, and filled their stadium to 95.5% capacity. Notre Dame, which went undefeated during the 2012 regular season and earned a spot in the BCS National Championship Game, has earned \$563.23 million in revenue, won 59.2% of its games, earned a total of 789.16 Sagarin points, and averaged 80,795 fans per game (100% capacity).

Table 2 FBS Institutions changing membership as a result of clustering.

Institution	Euclidian distance
“Relegated” Institutions	
Arizona	1.466
Baylor	0.935
Colorado	1.483
Duke	1.518
Illinois	1.268
Indiana	1.405
Iowa State	1.939
Kansas	1.091
Kentucky	1.365
Maryland	0.990
Minnesota	1.694
Mississippi State	1.971
NC State	1.709
North Carolina	1.572
Northwestern	1.295
Pittsburgh	1.612
Purdue	1.270
Syracuse	0.805
Vanderbilt	1.464
Virginia	1.320
Wake Forest	1.365
Washington	2.199
Washington State	0.929
“Promoted” Institutions	
Boise State	2.660
BYU	1.301
Louisville	1.680
Rutgers	1.588
South Florida	2.076

4 Study 2: The “super” conferences

The second study utilizing CA involves grouping the 45 Division IV institutions from Study 1 into four “super”

conferences based upon their financial, on-field, and attendance-related performance. Utilizing revenue, winning percentage, Sagarin rating points, average attendance, and percent capacity to cluster the institutions into four “super” conference groups resulted in the creation of four conferences of 10, 16, 13, and 6 institutions each. An analysis of variance (ANOVA) was utilized to confirm the statistical significance of the differences between the four clusters of institutions. Similar to the results for the first study, there were significant differences based upon all five variables at the $\alpha=0.05$ level, including revenue, $F(3, 41)=77.683$, $p<0.001$, winning percentage, $F(3, 41)=15.495$, $p<0.001$, Sagarin rating, $F(3, 41)=14.098$, $p<0.001$, average attendance, $F(3, 41)=68.649$, $p<0.001$, and percent capacity, $F(3, 41)=8.028$, $p<0.001$.

As indicated in Table 3, the first “super” conference created by CA includes five members of the SEC (Alabama, Auburn, Florida, Georgia, and LSU), three members of the Big Ten (Michigan, Ohio State, and Penn State), and two members of the Big 12 (Oklahoma and Texas). Over the past 10 years, these 10 programs averaged \$562.86 million in revenue (z -score=2.347), won 73.76% of their games (z -score=1.458), earned an average of 856.09 Sagarin rating points (z -score=1.544), averaged 95,773 fans per game (z -score=1.984) and filled their stadiums to an average capacity of 100.38% (z -score=0.981). These standardized

variables indicate that these programs have the highest revenue, Sagarin ratings, and attendance, and rank second in winning percentage and percent capacity (Figure 3).

“Super” conference 4, which ranks first in winning percentage (z -score=1.574) and percent capacity (z -score=1.226), includes two of the programs “promoted” into Division IV (Louisville and Boise State), two members of the Big 12 (TCU and West Virginia) and two members of the Pac-12 (Oregon and Utah). Over the past 10 seasons, these programs have won 75.45% of their games (z -score=1.574) and filled their stadium to 105.55% capacity (z -score=1.226). They also had average revenue of \$169.58 million (z -score=-0.109), earned an average of 818.19 Sagarin points (z -score=1.136) and had an average attendance of 48,366 fans per game (z -score=0.139). Given that both Texas and Boise State have been grouped together with other institutions (rather than on their own), it appears that cluster analysis has not deemed them to be outliers in the current college football landscape, despite their high on-field (Boise State) and financial (Texas) performance.

The next-strongest conference is “super” conference 3, which features three members of the ACC (Clemson, Florida State, and Virginia Tech), four members of the Big Ten (Iowa, Michigan State, Nebraska, and Wisconsin), one member of the Pac-12 (USC), four members of the SEC (Arkansas, South Carolina, Tennessee, and Texas

Table 3 Cluster membership in “super” conferences.

School	Cluster	Distance	School	Cluster	Distance
Alabama	1	0.570	Stanford	2	0.538
Auburn	1	0.746	Texas Tech	2	0.690
Florida	1	0.390	UCLA	2	1.063
Georgia	1	0.298	Arkansas	3	0.634
LSU	1	0.746	Clemson	3	0.480
Michigan	1	1.125	FSU	3	1.014
Ohio State	1	0.674	Iowa	3	0.418
Oklahoma	1	1.106	Michigan State	3	0.678
Penn State	1	0.966	Nebraska	3	0.469
Texas	1	1.089	Notre Dame	3	1.290
Arizona State	2	0.740	South Carolina	3	0.255
Boston College	2	0.693	Tennessee	3	0.943
BYU	2	0.831	Texas A&M	3	0.847
California	2	0.615	USC	3	1.706
Georgia Tech	2	0.538	Virginia Tech	3	1.030
Kansas State	2	0.607	Wisconsin	3	0.536
Miami (FL)	2	1.244	Boise State	4	1.245
Mississippi	2	1.072	Louisville	4	1.101
Missouri	2	0.866	Oregon	4	0.750
Oklahoma State	2	0.757	TCU	4	0.269
Oregon State	2	0.596	Utah	4	0.476
Rutgers	2	0.534	West Virginia	4	0.768
South Florida	2	1.199			

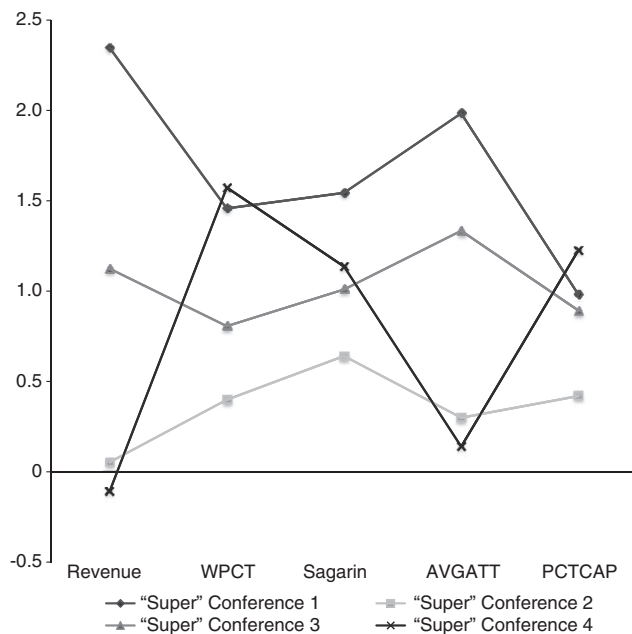


Figure 3 Profile diagram of means of standardized financial performance, on-field performance and attendance data for each of the four "super" conferences.

A&M) and one independent (Notre Dame). Over the past 10 seasons these programs have earned an average of \$367.01 million in revenue (z -score=1.124), won 64.25% of their games (z -score=0.806), earned an average of 806.39 Sagarin points (z -score=1.009), attracted an average of 79,062 fans to their games (z -score=0.139) and filled their stadiums to 98.52% capacity (z -score=0.893).

Finally, "super" conference 2 includes the 16 remaining members of the new Division IV, including two current members of the AAC (Rutgers and South Florida), three members of the ACC (Boston College, Georgia Tech, and Miami), three members of the Big 12 (Kansas State, Oklahoma State, and Texas Tech), five members of the Pac-12 (Arizona State, California, Oregon State, Stanford, and UCLA), two members of the SEC (Mississippi and Missouri), and one independent (BYU). These 16 programs have averaged \$195.52 million in revenue (z -score=0.053), won 58.3% of their games (z -score=0.398), earned an average of 772.10 Sagarin rating points (z -score=0.640), averaged 52,482 fans per game (z -score=0.299) and filled their stadiums to 88.53% capacity (z -score=0.419).

4.1 Discussion

The first "super" conference of 10 members includes the institutions that have won nine of the 10 BCS national

championships over the 10-year period included in the study (LSU, Texas, Florida, Alabama, and Auburn) plus the winner in the year prior to this period (Ohio State). The only BCS national champion over the past 10 seasons not included in the premier "super" conference was the 2004 BCS National Champion, USC. It appears that USC was left out of the top conference due in large part to its lower revenues. "Super" conference 3 was the landing place of USC, who despite their winning percentage of .814 over the past 10 years (z -score=1.981), was relegated to a lower-rated conference based upon their total revenues of \$300.21 million (z -score=0.707). USC's revenue was below that of the other members of its conference, which averaged total revenues of \$367.01 million. USC, unlike most NCAA FBS institutions, does not own its football stadium. It instead pays rent to play in the publicly-owned Los Angeles Memorial Coliseum, resulting in significantly lower revenues than other higher-performing institutions (Lin 2013). Additionally, USC plays in the Pac-12, a conference that traditionally has generated lower revenue than its peers. According to their 2011–2012 tax filing, the Pac-12 generated \$176 million in revenue, while the Big Ten generated \$315 million and the SEC \$273 million (Bachman 2013). Given the Pac-12's new \$3 billion media rights agreements with ESPN and FOX this is slated to change, and USC's revenue will increase in the coming years (Bachman 2013). The University of Miami is in a similar situation (Hanks and Mazzei 2013). Miami, which pays rent to play its games at off-campus Sun Life Stadium, was relegated to "super" conference 2 due in large part to its lower revenues (z -score=0.255) and a percent capacity of just 63.7% (z -score=-0.757), the lowest among the study's BCS AQ institutions.

The "super" conference re-conceptualization created by cluster analysis has also created what could be termed a "doing less with more" conference. Recall that the six members of "super" conference 4 boast a higher average winning percentage (.754, an average z -score of 1.574) than the members of "super" conference 1 (.738, a z -score of 1.458), despite this conference featuring nine of the past 10 BCS National Champions. These six programs also fill their stadiums to an average capacity of 105.55% (z -score=1.226), while the top "super" conference only fills its stadiums to 100.38% capacity (z -score=0.980). These six programs (Boise State, Louisville, Oregon, TCU, Utah and West Virginia) have also averaged only \$16.96 million per season in revenue over the past 10 seasons, considerably less than the members of "super" conference 1 (\$56.29 million), "super" conference 3 (\$36.70 million) and "super" conference 2 (\$19.55 million). Therefore, it appears that despite these six members of "super" conference 4 having considerably smaller stadiums than the

10 members of “super” conference 1 (average attendance of just 48,466 vs. 95,773), they have consistently outperformed them on the field. These results help illustrate the value of analyzing the performance of college football programs using analytics, as it helps uncover both under-performing and over-performing programs.

5 Implications and limitations

Not only could the data analysis techniques employed in this paper be helpful to conference administrators in identifying the most attractive potential members, analytics could also be useful in grouping institutions into divisions, based not on geography but on performance. Utilizing an advanced statistical technique to cluster institutions based on data will likely result in improved competitive and financial balance within the two conference divisions. Some have suggested that scheduling may have increased importance in the new era of the College Football Playoff, in evaluating programs’ suitability for inclusion in the four-team Playoff. Clustering college football programs based on analytics may assist members of the new College Football Playoff selection committee in evaluating the strength of schedule of certain programs. For example, points may be allocated based on scheduling (and defeating) programs in higher tiers, rather than programs placed in lower tiers.

However, the utility of the approaches explored in this paper is limited by its conceptual nature. Most conference commissioners and administrators are more concerned with competitive balance *between* divisions of the conference, rather than *within* the divisions (Rittenberg 2013). In addition, an individual institution’s financial performance (particularly its revenue) is heavily dependent on its conference affiliation, limiting the ability to isolate a football program’s true financial performance.

Similarly, this study focused solely on NCAA FBS football programs’ revenue and expenses, and did not explore each program’s net revenue. Given that universities are generally classified as non-profit organizations, the NCAA is careful to avoid the term profits, and instead defines net revenue as an individual athletic program’s revenues minus expenses (Fulks 2013). Future research should explicate each program’s net revenue, which may reveal important insights as to the most efficient NCAA football programs. A better measure of a football program’s true financial performance may be based on its efficiency, rather than how much it spends or earns.

6 Conclusion

The utilization of an advanced multivariate data analysis technique appears to have had several applications in an examination of the financial and on-field performance of college football programs. First, the technique was utilized to re-configure the current FBS hierarchy, resulting in a total of 23 institutions being relegated from “power” conference status based upon their financial and on-field performance. Meanwhile, several institutions were promoted from outside the current “power” conference structure to inclusion in a re-conceptualized Division IV, which includes a grouping of 45 FBS institutions. Based on performance data, rather than grouping all members of the five “power” conferences together, the data suggests that not all programs deserve to be placed in this highest tier, while some institutions outside the “power” conference structure such as Boise State, Louisville and Brigham Young would deserve this status. These findings may help to provide a call for change to administrators and alumni of the “relegated” institutions, who over the past 10 years have not been performing to the standard of their status as a BCS AQ qualifier and member of a “power” conference. Finally, CA was utilized to re-conceptualize the current conference configurations in college football, clustering the institutions based not on geography, tradition and like-mindedness but on their actual performance on and off the field. The results indicated that statistical techniques would place the 45 FBS institutions in four “super” conferences with a total of 10, 16, 13 and 6 institutions each. This paper provides empirical evidence that current conference commissioners and administrators, in their rush to expand their conference to 16 teams, may be well to consider limiting the conference to a smaller number (similar to the approach currently taken by the Big 12 Conference). Based on this study’s findings, a grouping of a smaller number of institutions (such as the groups created by CA), may better group institutions together based on financial and on-field performance and could result in improved competitive balance. This is evidence as to why this paper’s findings have important implications for intercollegiate athletic administrators, who in this age of increased scrutiny and uncertainty should be turning to statistics to improve upon decision-making.

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