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Efficiency Analytics of NCAA Division I College Football Programs

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Abstract

College athletics are a multi-billion dollar industry in the United States, but how well do university athletic programs employ their resources? The question is germane in light of increasing costs of higher education and scrutiny of university budgets. This study furnishes a template to weigh the tradeoffs inherent in collegiate sports, which is the main contribution of the paper. A dataset of 117 American college football programs from 2011-2015 is analyzed using DEA and AHP methods to assess the efficiency and perception of these programs. The result is the aforementioned framework measuring the programs' success and answers the question of program efficiency.

Keywords: *AHP, DEA, college sports, resource allocation, sport performance*

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Introduction

College athletics in the United States is a big business. In 2017, thirty-one universities in Division I, the highest classification of athletics, had revenues over $100 million dollars from their respective athletic programs (USA Today, 2018). These universities continue to invest scarce resources in these athletic programs with the main goal of producing winning teams, especially in the revenue-generating sports of men's basketball and American football. Are these resources well-spent? This question bedevils campus administrators, state legislators, fans, and other stakeholders of college athletics (Hutchinson & Bouchet, 2014). This study examines how efficiently NCAA Division I American football (hereafter "football") programs employ their resources. Football is the research setting because the sport accounts for a disproportionate share of athletic department revenue and garners the most media exposure for the university (Fulks, 2016). A unified framework for evaluating the efficiency of college football programs and recommendations for improving their performance are the outcomes.

Despite record levels of spending and resources allocated to college athletics, there is little research and discussion regarding their efficiency. This study aims to fill this gap. The overall performance of college football programs are ranked via both quantitative and qualitative approaches. Football is a revenue-generating sport, particularly with regard to media sources such as TV contracts, but it is also costly to maintain given the high expenses associated with coaches' salaries, player scholarships, equipment, travel, etc. This work initiates the academic conversation on this subject by looking into their performances and efficiency.

Data Envelopment Analysis (DEA: Charnes, et al., 1978; Cooper et al., 2006) and Analytic Hierarchy Process (AHP: Saaty, 1977, 1990) are the methods for examining the productivity of NCAA Division I football programs. As such, each football team is a decision-making unit (DMU). Practitioners often find it difficult to measure performances when various inputs and outputs are involved (Sueyoshi et al. 2009). This paper builds on Haas's (2003) study of English football teams and Major League Soccer (2003), exploring NCAA Football programs' performance.

The main contribution is a framework to judge the efficiency of college football programs. This framework is a practical way to evaluate the tradeoffs inherent to competing in college football in terms of resources expended and outcomes obtained. University sports is an area where efficiency has been unknown until recently; the focus has been on winning games no matter the cost, especially in the major revenue sports of men's basketball and football. In the increasing competitive and budget-conscious realm of higher education, the framework can be a powerful tool for administrators to allocate scarce resources. This work is also valuable to the public, who hankers for more transparency on how universities spend their money given their tax-exempt status and, in the case of public universities, their direct support from taxpayers via state legislatures.

Literature Review

The DEA model (Charnes et al., 1978; Cooper et al., 2004) is used to build an efficiency frontier and establish benchmarks for multiple decision-making units (DMUs). Each football program is a DMU. DEA is a linear programming technique that measures the relative efficiency (productivity) of DMUs involving multiple outputs and inputs. DEA has been used as an instrument to measure productivity of on-the-field play (e.g. Anderson & Sharp 1997; Einolf, 2004; Barros & Santos, 2003; DeMello et al., 2009; Moreno & Lozano 2014). Mazur (1994) uses DEA to evaluate baseball performance, while Collier et al. (2010) use DEA to analyze multiple sports. Finally, Garcia-Sanchez (2007) applies DEA to football games, but it differs from this study in that they separate a teams' performance into offence and defense efficiency, athletic/operating effectiveness, and social effectiveness.

Data and Methods

To determine the proper inputs and outputs, 41 people with knowledge in the field were emailed to develop external validity for the study. These people fell into two categories: (1) academic faculty members with expertise in this field, or (2) athletic department personnel that oversees or has a working knowledge of their institution's football program. These domain experts considered the relationship between these inputs and the performance of an intercollegiate football program. Data for the variables in this DEA model over the four-year span between 2011 and 2015 for 117 Division I FBS programs were gathered, which is virtually the entire population. The names of the universities and their DMU IDs appear on Table 1.

There are four input and four output measures. The inputs pertinent to operating a Division I football program includes: (a) coach's salary, (b) operating expenses per participant, (c) total expenses by team, and (d) university enrollment. Because universities do not compensate their athletes, the money tends to flow into coaching salaries and athletic facilities. Coaches with high compensation packages are often excellent recruiters. Thus, coaching salaries are an important input.

The relevant outputs include (a) attendance, (athletic output), (b) revenue derived by the football program, (c) team's win/loss record, and (d) final end-of-the season ranking in inverse order, so that the larger this output is the better the team is. Total revenue produced by a team is a commercial output. The final rankings are the Sagarin rankings. The Sagarin rankings are a composite ranking of all Division I football programs that is published weekly in the USA Today newspaper. Since mainstream media covers these college athletic programs, these outputs were easily accessible.

Data from numerous secondary sources are used, including the Equity in Athletics Data analysis website, mainstream media sites, and university websites. The efficiency for 29 alphabetically ordered teams appear on the rightmost column of Table 2 as an example of how DEA works. If the team operate efficiently relatively to other teams, DEA shows an efficiency score of 1. When the efficiency score is smaller than 1, it implies the team is not operating efficiently. DEA establishes the frontier of efficiency and each team's relative position to that frontier.

DMU3 is an example. First, an imaginary composite team, based on all DMUs, is established. Each output of the composite team is a weighted average of the corresponding outputs of all DMUs. Each input for the composite team can be determined similarly by using the same weights. The LP model constraints will require all outputs for the composite team to be at least equal the outputs of the evaluated DMU3. When the inputs for the composite team is less than those for DMU3, the composite team has more outputs for less input. Then, DEA would conclude the composite team is more efficient than DMU3, i.e. DMU3 is less efficient than the composite team. As the composite team incorporates all FBS teams, the evaluated DMU3 is thus relatively inefficient

In addition to the output constraints above, the inputs must be considered to ensure that the Input for the composite team ≤ Input for DMU3. The input of Coach's salary (in $000) for the composite team is

$$w1*(\$400) + w2*(5546) + w3*(\$550) + \ldots..w117*(1200).$$

DEA uses decision variable E to define the efficiency of DMU3, which correspond to the percentage of DMU3's input available to the composite team. Table 2 shows DMU3's Coach Salary is $550 thousand. Hence, 550*E is the salary available to the composite team coach. If $E = 1$, the Coach's Salary available to the composite hospital is 550. When $E \geq 1$, the composite team will have higher salary available for the coach, while $E \leq 1$ indicates the composite team has less salary available for the coach. E is thus an efficiency index.

Although DEA has proven effective in measuring quantitative features, AHP is suitable for qualitative analysis. Analytic Hierarchy Process (Saaty 1977, 1990) is a multi-criteria process based on pairwise comparisons for subjective elements in a hierarchy, e.g. perceived quality of coaches. In this study, DEA experts were asked to suggest the relevant criteria to collect the data for pairwise comparisons. Saaty and Ozdemir (2003) and Lee and Walsh (2011) suggest the number of criteria included in the AHP for pairwise comparison matrix should no more than seven; there are five factors in this matrix.

It is necessary to identify the relevant criteria for AHP. Perceived regional high school athlete quality is the first one. For example, intuition suggests that the Southeastern US produces better high school athletes than the Rocky Mountain region. It is therefore easier to have a successful football program in the Southeast than in the Rocky Mountain States simply because of the difference in available local talents and supporting infrastructure for high school athletics.

The second and third criteria are the perceived capabilities of the head coaches and their years of coaching experience. Talent matriculates to college football programs much differently than it does in the corporate sector. Typically, the football coaching staff at the university recruits potential student-athletes based on their belief in the player's future. Because styles of play differ among football programs, it is important to align expectations between the player and the coach.

The fourth criteria is the individual school's perceived tradition, which plays a significant role in the recruiting of student-athletes. A university's athletic facilities serve as a key differentiator among teams and is the fifth criterion. Four athletic directors of Division 1 programs evaluated these factors. To consolidate their opinions, the participants must provide a concurred input, or the geometric mean of all judgments must be calculated (Saaty, 1980; Aczel & Saaty, 1983). The latter is used.

To convert the pairwise comparisons matrix into weights, the AHP employs an eigenvector scaling method to transform the opinions into numerical scores. The inconsistency ratio (Saaty, 2008) at each level of the proposed AHP hierarchy is below 0.1, indicating the subjective judgments given by domain experts are quite consistent.

Results

The efficiency for 29 alphabetically ordered teams appear on the rightmost column of Table 2. If the team operate efficiently relatively to other teams, DEA shows an efficiency score of 1. When the efficiency score is smaller than 1, it implies the team is not operating efficiently. For instance, DMU3 has an efficiency score of .9046, i.e. the team could improve its efficiency and productivity, by benchmarking the teams listed in its reference set. From Table 3(a), DMU3's references (benchmark teams) are: DMU36 (.7988), DMU47 (.094), DMU73 (.0193), and DMU83 (.088). The values inside the parentheses are the relative importance (weight) corresponding to each team in evaluating DMU3; thus, DMU36 is the most important team for DMU3 to learn from.

In Table 2, DMU3 shows the Coach Salary is $550,000, and Operating Expenses per participant is $7,884. Table 3(b) provides detailed information on each DEA's Slacks and Surpluses relative to its benchmark teams. From its 0.9046 efficiency rating, DMU3 could achieve the same output with no more than $497,530 (=0.9046*$550,000). Table 3(b) shows an excess input of Coach Salary of $73,079, and Operating Expenses per Participant of $135.6. To become efficient, DMU3 should cut down these two expenses (inputs amount). Note that, each excess input shown here is the reduction in input that should be done beyond that implied by .904587*Input Measure.

The shortage given in columns (8)-(11) in Table 3(b) relate to output performances. It shows that the benchmark has produced more outputs than the evaluated DMU by the amount shown in that row. Specifically, DMU3 has attracted less attendance than the benchmark, and should increase the attendance by 473, and improve their Win/Loss ratio by .224 (see columns 8 and 10) in order to become efficient, i.e. move to the frontier. Evidently, the benchmark unit is performing better than DMU3, and it is reasonable to declare that DMU3 is less efficient relative to comparable teams (i.e. the benchmarking DMUs # 36, 47, 73, 83). DMU3's management needs to utilize its resources more efficiently.

As a further example, to be efficient, DMU 19 with a score of .4816 needs to reduce the coach's salary by $457,518, improve attendance by 3,430 people, and improve the final ranking by 43 places. DEA provides efficiency information and offers directions for improvement; it indicates which inputs to spare and the expect amounts of outputs. Table 4 shows the AHP verbal judgment for all teams. As an example, Team 29's (same ID number as DMU29) AHP scores is 0.99 (see the rightmost column), while that for Team 8 is .15.

Table 1
List of Universities and their Corresponding DMU IDs

ID	University	ID	University	ID	University	ID	University
1	Akron	31	Georgia	61	Missouri	91	Stanford
2	Alabama	32	Georgia Tech	62	Nebraska	92	Syracuse
3	Arizona	33	Hawaii	63	Nevada	93	Temple
4	Arizona State	34	Houston	64	Nevada-Las Vegas	94	Tennessee
5	Arkansas	35	Idaho	65	New Mexico	95	Texas
6	Arkansas State	36	Illinois	66	New Mexico State	96	Texas A&M
7	Auburn	37	Indiana	67	North Carolina	97	Texas Christian
8	Ball State	38	Iowa	68	North Carolina State	98	Texas Tech
9	Baylor	39	Iowa State	69	North Texas	99	Texas-El Paso
10	Boise State	40	Kansas	70	Northern Illinois	100	Toledo
11	Boston College	41	Kansas State	71	Northwestern	101	Troy
12	Bowling Green	42	Kent State	72	Notre Dame	102	Tulane
13	Brigham Young	43	Kentucky	73	Ohio	103	Tulsa
14	Buffalo	44	Louisiana Tech	74	Ohio State	104	UCLA
15	California	45	Louisiana-Lafayette	75	Oklahoma	105	Utah
16	Central Florida	46	Louisiana-Monroe	76	Oklahoma State	106	Utah State
17	Central Michigan	47	Louisville	77	Oregon	107	Vanderbilt
18	Cincinnati	48	LSU	78	Oregon State	108	Virginia
19	Clemson	49	Marshall	79	Penn State	109	Virginia Tech
20	Colorado	50	Maryland	80	Pittsburgh	110	Wake Forest
21	Colorado State	51	Massachusetts	81	Purdue	111	Washington
22	Connecticut	52	Memphis	82	Rice	112	Washington State
23	Duke	53	Miami	83	Rutgers	113	West Virginia
24	East Carolina	54	Miami Ohio	84	San Diego State	114	Western Kentucky
25	Eastern Michigan	55	Michigan	85	San Jose State	115	Western Michigan
26	Florida	56	Michigan State	86	South Carolina	116	Wisconsin
27	Florida Atlantic	57	Middle Tennessee State	87	South Florida	117	Wyoming

Table 1 (continued)

28	Florida International	58	Minnesota	88	Southern California
29	Florida State	59	Mississippi	89	Southern Methodist
30	Fresno State	60	Mississippi State	90	Southern Mississippi

Table 2

Example Inputs and Outputs of DMU's for DEA Model

ID	(I) Coach Salary	(I) Operating _expenses_ per_ participant	(I) Total ex-penses by team	(I) University_ enrollment	(O) Attenda nce	(O) Total_ Revenue_ produced_ by_ Team	(O) Win_Loss Ratio	(O) Final Ranking	DEA Efficiency
1	400,000	8,181	6,785,813	16,642	9,275	6,785,813	0.1	119	0.992
2	5,545,852	56,626	41,558,058	25,109	101,722	88,660,439	13.0	1	1.000
3	550,000	7,884	7,025,640	8,224	15,271	7,241,632	0.3	110	0.905
4	2,150,000	41,768	20,111,388	28,063	47,931	28,415,445	1.6	38	0.539
5	2,303,020	47,413	23,509,311	49,870	56,835	39,210,883	1.6	40	0.618
6	5,158,863	41,832	29,861,957	17,687	68,046	61,492,925	0.5	79	0.921
7	724,597	10,921	5,748,516	7,717	26,398	5,748,516	3.3	25	0.727
8	2,440,000	28,596	36,306,282	18,449	82,646	75,092,576	0.3	88	1.000
9	399,000	9,263	5,926,855	15,594	12,930	5,926,855	2.3	50	0.847
10	2,426,360	32,658	20,299,526	12,589	41,194	26,270,277	1.6	31	0.611
11	2,151,500	22,140	9,200,027	12,718	35,404	15,284,248	5.5	19	0.673
12	1,600,000	36,929	19,703,856	9,383	37,020	22,939,275	0.2	108	1.000
13	401,000	11,252	6,171,184	13,665	15,632	6,171,184	1.6	60	0.808
14	900,000	16,600	14,428,930	28,338	61,161	18,639,413	1.6	27	1.000
15	325,000	14,661	6,480,242	17,573	13,242	6,480,242	0.5	96	1.000
16	2,394,000	33,825	23,071,010	25,018	55,876	37,660,430	0.3	84	0.702
17	1,534,728	26,346	15,076,608	36,678	34,608	14,712,259	2.5	36	0.455
18	360,600	10,095	6,740,097	18,283	16,036	6,750,120	1.2	80	0.945
19	3,143,000	18,798	16,458,502	19,615	29,137	16,458,502	3.3	30	0.482
20	2,550,024	42,914	19,969,497	15,570	81,427	41,273,517	5.5	14	1.000
21	2,403,500	33,503	19,781,626	23,466	45,373	30,547,707	0.1	120	1.000
22	1,350,000	19,950	11,253,326	20,189	19,250	11,253,326	0.5	106	0.569
23	1,700,000	35,168	13,711,350	16,587	34,672	11,142,560	0.7	85	0.584
24	1,792,285	27,069	19,234,750	6,484	28,170	24,121,573	0.9	74	0.837
25	1,150,000	23,844	9,915,950	18,187	47,013	10,083,420	1.6	72	1.000
26	374,937	5,222	5,448,838	13,092	3,923	6,289,724	0.2	114	1.000
27	2,734,500	69,093	25,704,553	29,984	87,597	74,820,287	5.5	4	0.973
28	497,224	13,251	6,726,618	15,389	13,459	7,287,694	0.3	104	0.834
29	500,000	13,945	8,168,228	23,698	13,634	8,168,228	0.3	103	0.767

Table 3

Example DEA Outputs

(a) Reference Set for Each Team to Benchmark

No.	DMU	Score		Reference	set (lambda)								
1	1	0.992025	36	26	0.251731	36	0.549031	67	0.187889	73	1.13E-02		
2	2	1	1	2	1								
3	3	0.904587	49	36	0.798754	47	9.40E-02	73	1.93E-02	83	8.80E-02		
4	4	0.538609	114	47	0.686468	56	0.149998	73	0.127096	96	3.64E-02		
5	5	0.617612	108	47	0.485572	56	0.163727	73	0.216338	96	4.66E-02	97	3.49E-02
6	6	0.920687	47	8	0.501937	36	0.202715	39	0.104827	73	0.12921	96	6.13E-02
7	7	0.727393	95	47	0.945522	49	3.08E-02	73	4.61E-04	75	1.36E-03	104	2.18E-02
8	8	1	1	8	1								
9	9	0.847056	58	26	0.34202	47	0.63624	73	2.10E-02	75	7.60E-04		
10	10	0.611165	109	47	0.50799	49	0.144661	73	0.149091	104	0.198258		
11	11	0.67342	103	47	0.870143	56	5.44E-02	73	3.28E-03	75	3.19E-03	96	0.06901
12	12	1	1	12	1								
13	13	0.808123	70	26	9.09E-02	47	0.874242	73	3.49E-02				
14	14	1	1	14	1								
15	15	1	1	15	1								
16	16	0.701516	98	8	0.165459	36	0.145934	56	0.191031	91	0.078297	97	7.96E-02
17	17	0.455	118	47	0.572271	73	4.38E-02	75	1.75E-04	96	0.013437	97	0.115621
18	18	0.94486	43	15	0.158237	26	0.275518	47	0.537795	73	2.84E-02		
19	19	0.481578	117	36	0.291709	47	0.433748	49	0.169798	75	1.64E-03	102	0.103101
20	20	1	1	20	1								
21	21	1	1	21	1								
22	22	0.568711	113	26	1.50E-02	36	0.665366	75	1.08E-04	96	5.15E-02	102	0.268012
23	23	0.584439	111	47	0.462014	56	0.024221	89	3.08E-02	91	0.400909	95	8.20E-02
24	24	0.837086	61	8	4.44E-02	73	0.128878	83	0.414706	111	0.411998		
25	25	1	1	25	1								
26	26	1	1	26	1								
27	27	0.973338	38	47	0.121039	56	0.338448	73	0.395604	96	0.14491		
28	28	0.833715	62	26	0.356203	36	0.335437	47	6.64E-02	73	1.86E-02	102	0.223348
29	29	0.766963	83	15	5.33E-02	26	0.435655	36	0.101329	47	0.175328	67	0.200987
30	30	0.742492	89	14	0.318327	47	0.196272	56	0.381815	73	0.103587		

Table 3 (continued).
(a) Slacks and Surpluses

No.	DMU	Score	Excess Coach salar S-(1)	Excess Operating S-(2)	Excess Total expen S-(3)	Excess University_enrollment S-(4)	Shortage Attendance S+(1)	Shortage Total Revenue S+(1)	Shortage Win_Loss S+ (3)	Shortage Final Rankin S+ (4)
1	1	0.992025	0	0	679362.2	6495.683082	2214.277	0	0.162623	0
2	2	1	0	0	0	0	0	0	0	0
3	3	0.904587	73078.52	135.6139	0	0	472.6933	0	0.223651	0
4	4	0.538609	0	161.8028	0	5177.656142	0	0	1.345482	9.21678
5	5	0.617612	0	0	0	18616.71154	0	0	2.369629	0
6	6	0.920687	2551170	9065.157	0	0	0	0	1.42662	0
7	7	0.727393	96713.5	0	0	0	695.5057	0	0	34.72705
8	8	1	0	0	0	0	0	0	0	0
9	9	0.847056	0	0	374684	5297.489984	6080.773	0	0	28.48674
10	10	0.611165	406303.4	0	0	0	910.4016	0	2.211025	9.072004
11	11	0.67342	577514.9	2620.759	0	0	0	0	0	37.81062
12	12	1	0	0	0	0	0	0	0	0
13	13	0.808123	0	0	496728.9	5124.316244	9383.41	0	0.235726	4.630921
14	14	1	0	0	0	0	0	0	0	0
15	15	1	0	0	0	0	0	0	0	0
16	16	0.701516	0	0	0	104.3195561	0	0	0.67019	0
17	17	0.455	0	0	0	6298.698531	0	0	0	21.32596
18	18	0.94486	0	0	1158021	7918.917345	2873.502	0	0.169427	0
19	19	0.481578	457518.3	0	0	0	3429.804	0	0	42.98914
20	20	1	0	0	0	0	0	0	0	0
21	21	1	0	0	0	0	0	0	0	0
22	22	0.568711	85844.92	4571.139	0	1432.663873	0	0	0	0
23	23	0.584439	0	8870.57	0	0	0	1182235	0.559156	0
24	24	0.837086	55945.17	0	76402.43	0	6666.235	0	1.482309	0
25	25	1	0	0	0	0	0	0	0	0
26	26	1	0	0	0	0	0	0	0	0
27	27	0.973338	0	16980.63	0	10782.43767	0	0	0.308471	15.60636
28	28	0.833715	0	4707.252	0	2814.642781	0	0	0.257346	0
29	29	0.766963	0	0	0	7215.26235	0	0	0.489649	0

Table 4
Verbal Description and AHP Final Ratings (29 teams in Alphabetical Order)

Team #	Perceived regional high school athlete quality	Perceived Head Coach's capabilities	Head Coach's years of experience	Perceived school's tradition	Perceived Level of Facilities	Rating Perceived regional high school athlete quality	Rating Perceived Head Coach's capabilities	Rating Head Coach's years of experience	Rating Perceived school's tradition	Rating Perceived Level of Facilities	Weighted Score	Idealized Score
Weighted	0.567	0.188	0.078	0.086	0.081	0.567	0.188	0.078	0.086	0.081		
1	Very Good	Average	3-6	Average	Average	0.260	0.122	0.110	0.106	0.133	0.20	0.41
2	Outstanding	Excellent	1-3	Excellent	Excellent	0.503	0.558	0.052	0.557	0.503	0.48	0.98
3	Good	Above Average	>10	Excellent	Excellent	0.134	0.263	0.606	0.284	0.503	0.24	0.49
4	Good	Above Average	6-10	Above Average	Above Average	0.134	0.263	0.232	0.284	0.305	0.19	0.39
5	Very Good	Above Average	6-10	Above Average	Average	0.260	0.263	0.232	0.284	0.133	0.25	0.51
6	Good	Average	1-3	Average	Weak	0.134	0.122	0.052	0.106	0.059	0.12	0.24
7	Outstanding	Above Average	3-6	Excellent	Excellent	0.503	0.263	0.110	0.557	0.503	0.43	0.88
8	Below Average	Average	3-6	Average	Average	0.035	0.122	0.110	0.106	0.133	0.07	0.15
9	Outstanding	Above Average	6-10	Weak	Above Average	0.503	0.263	0.232	0.053	0.305	0.38	0.78
10	Below Average	Average	1-3	Above Average	Average	0.035	0.122	0.052	0.284	0.133	0.08	0.17
11	Very Good	Average	1-3	Average	Average	0.260	0.122	0.052	0.106	0.133	0.19	0.40
12	Outstanding	Average	1-3	Average	Average	0.503	0.122	0.052	0.106	0.133	0.33	0.68
13	Average	Average	6-10	Above Average	Average	0.068	0.122	0.232	0.284	0.133	0.11	0.23
14	Average	Average	1-3	Weak	Average	0.068	0.122	0.052	0.053	0.133	0.08	0.16
15	Outstanding	Average	3-6	Average	Above Average	0.503	0.122	0.110	0.106	0.305	0.35	0.71
16	Outstanding	Average	>10	Average	Average	0.503	0.122	0.606	0.106	0.133	0.38	0.77
17	Good	Average	3-6	Weak	Average	0.134	0.122	0.110	0.053	0.133	0.12	0.25
18	Very Good	Above Average	>10	Average	Average	0.260	0.263	0.606	0.106	0.133	0.26	0.54
19	Outstanding	Excellent	3-6	Above Average	Above Average	0.503	0.558	0.110	0.284	0.305	0.45	0.91
20	Average	Average	3-6	Average	Average	0.068	0.122	0.110	0.106	0.133	0.09	0.18
21	Average	Average	1-3	Average	Average	0.068	0.122	0.052	0.106	0.133	0.09	0.17
22	Good	Average	6-10	Average	Average	0.134	0.122	0.232	0.106	0.133	0.14	0.28

Table 4 (continued)

23	Good	Above Average	6-10	Weak	Average	0.134	0.263	0.232	0.053	0.133	0.16	0.32
24	Good	Average	3-6	Average	Average	0.134	0.122	0.110	0.106	0.133	0.13	0.26
25	Average	Average	1-3	Weak	Weak	0.068	0.122	0.052	0.053	0.059	0.07	0.15
26	Out-standing	Above Average	3-6	Excellent	Excellent	0.503	0.263	0.110	0.557	0.503	0.43	0.88
27	Out-standing	Average	1-3	Weak	Average	0.503	0.122	0.052	0.053	0.133	0.33	0.67
28	Out-standing	Average	1-3	Weak	Average	0.503	0.122	0.052	0.053	0.133	0.33	0.67
29	Out-standing	Excellent	3-6	Excellent	Excellent	0.503	0.558	0.110	0.557	0.503	0.49	0.9

Discussions and Implications

In the DEA Results, among the 117 teams, 35 DMUs (Teams) tied at the highest level with a score of 1. While the efficiency of these teams is the highest according to DEA model, it should be noted that the results could change when the mix of inputs and outputs change. The ID number is useful for locating the university on the Efficiency and Perception matrix (Figure 2).

Recall that the AHP scores in Table 4 are the normalized weighted average based on the a) perceived regional high school athlete quality, b) perceived head coach's capabilities, c) head coach's years of experience, d) perceived school's tradition, and e) perceived level of facilities. While there are many universities famous for their football heritage, there are some surprises. Troy University (#101), the University of Houston (#34), the University of Central Florida (#16), and San Diego State (#84) all benefit in these rankings because of their proximity to high-quality recruits. These schools are located in Houston, Atlanta, Southern California and Florida, fertile recruiting areas for college football programs.

Figure 1 contains the scatterplots of the teams using their DEA and AHP scores. The y-axis captures efficiency from the DEA, while the x-axis plots the perceptions from the AHP. The quadrants depict four states of the world: 1) High Efficiency, High Perception, 2) High Efficiency, Low Perception, 3) Low Efficiency, Low Perception, and 4) Low Efficiency, High Perception. Quadrant I is the space where DMUs with high scores from both DEA and AHP reside. Quadrant 2 indicates the football team in this space is highly efficient, yet the perception of the program per the AHP is low. Quadrant 3 is the general condition of both low efficiency and low quality. Quadrant 4 depicts low efficiency, but good perception.

Top teams appear in the upper right Quadrant of the matrix, with high-DEA, high-AHP DMUs. There are 58 universities in Quadrant 2, ranging from the University of Notre Dame (ID# 72) to Ball State University (#8). The state of Indiana is the location for both university teams and is the principal reason why the former is at the frontier of Quadrant 2 but not in it. Indiana does not contain the same level of high school talent as other areas of the country, which is the most critical factor in the AHP. The schools in this quadrant are using their resources well (High DEA efficiency) to produce the measurable outputs of team revenue, fan attendance, and success on the field via final standings, but they are lagging in others' perceptions of their talent pool, coaching capabilities, overall tradition, and/or facilities.

Of greater interest are the two remaining quadrants. Quadrant 3 is the home of low-efficiency, low-perception football programs. These DMUs are not, relatively speaking, using their inputs well to deliver team revenues, attendance, and victories, nor are they highly regarded. It is interesting to note that all sixteen programs (including #18) in this quadrant are large, public universities except for Boston College.

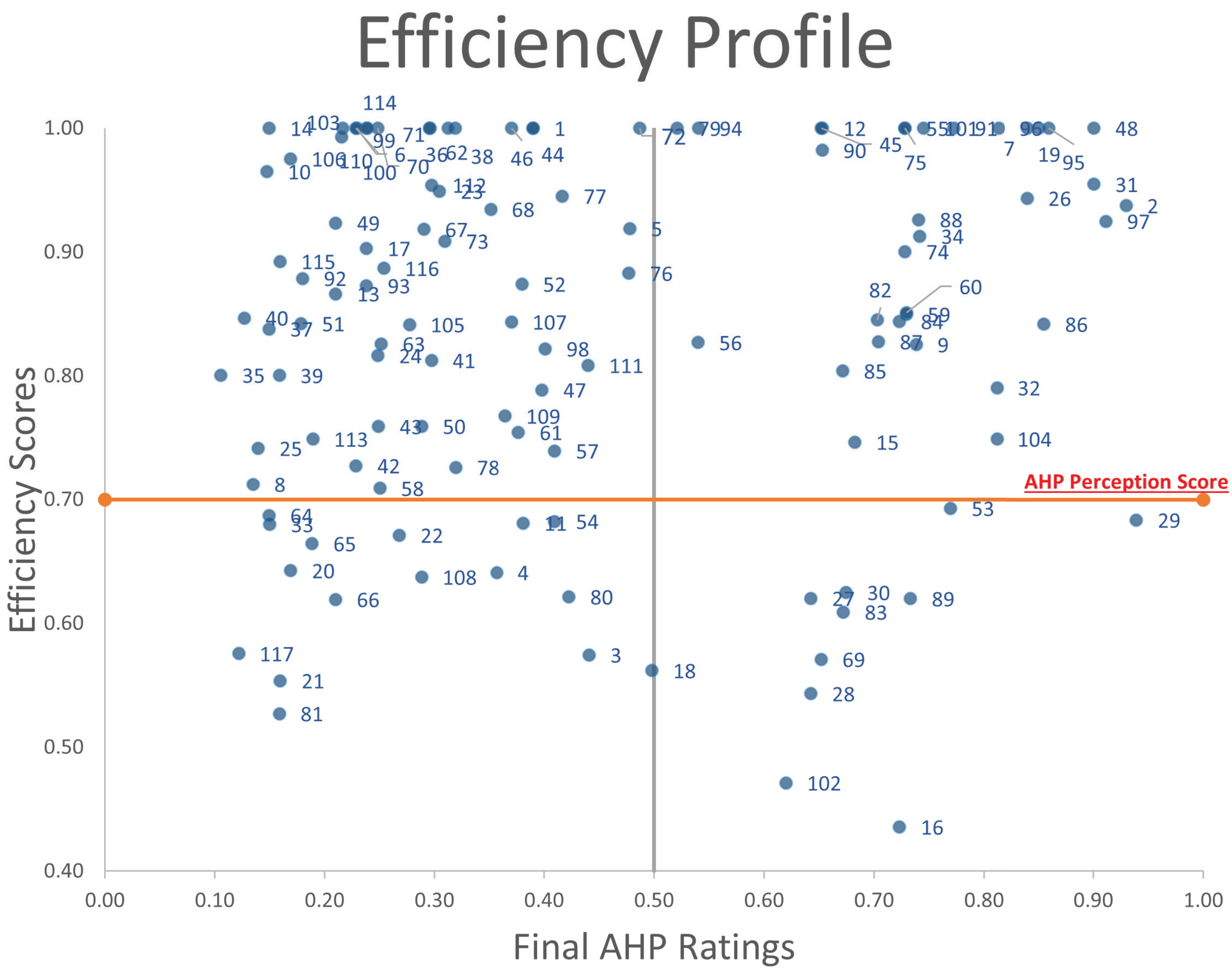
Ten DMUs that are inefficient yet perceived well are in Quadrant 4. The two highest AHP scores belong to Florida State University and the University of Miami, both of which are familiar to football fans. It is somewhat surprising to find them in this quadrant, perhaps because of the halo effect, but also noteworthy is the fact that five of the twelve universities are in the state of Florida. The University of Miami, Southern Methodist University (SMU), and Tulane University are the only private institutions in this quadrant. The latter may be inefficient due to the lingering effects of Hurricane Katrina, and SMU notoriously had its football season canceled in 1987 (the so-called NCAA "death penalty"; diminishing the future of the program), but these are only conjectures.

This work has practical implications. Given the amount of spending/resources these programs consume, efficiency is important. For example, while the universities with DMUs in Quadrant 3 may wish to keep their programs, the fact that they currently exist in a low-efficiency, low-prestige state relative to other programs should trigger conversations about resource allocation. In most instances, universities support athletics by diverting funds from the central budget. These funds could support other initiatives that provide a more direct benefit to the university. One option is for these schools is to drop football, as the University of Chicago famously did back in 1939 as well as more recently examples such as Long Beach State (1991), California State Fullerton (1992), and the University of the Pacific (1995). Another alternative is to move from Division I college football to a less competitive/resource-intensive division such as Division II or Division III.

If the university does not select either of these options and wants to maintain a Division I program, then this analysis offers the relevant tradeoffs. DEA enables stakeholders to see which input/output combinations are driving the overall efficiency score, and specific areas such as operating expenses per participant where improvement would generate the highest return to overall efficiency. Likewise, for those programs that are efficient but are not highly perceived (Quadrant 2), factors other than local high school talent can be augmented to increase perceptions. Admittedly, university administrators have less control over perceptions relative to other items like operating expenses, but they could perform similar analyses to identify likely causes of suboptimal performance.

Figure 1

Efficiency and Perception Profile



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