Coach's Intuition and Analytics

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Abstract
The head basketball coach at the University of St. Thomas, Houston, TX, an NAIA member, has six objectives for his team each game: less than 10 offensive rebounds for the opponents, draw at least 3 charges, keep the opposition under 65 points, shoot at least 45%, have at least 16 assists, and have less than 12 turnovers. The coach believes that meeting at least three of these objectives is associated with a higher chance of winning a game. This study analyzes data from NAIA box scores for the 2009-2010 through 2013-2014 seasons to see the proportion of games won when at least three of the objectives are met for the particular team (charges will not be included). This study will also examine if these objectives apply across all NAIA Division I men's basketball games from the 2009-2010 through the 2013-2014 seasons (adjusting for pace).

Key Words: Basketball; Coach's Objectives; NAIA

1. Introduction

The introduction of analytic methods into sports has allowed individuals to gain greater insight into factors that may influence winning games. However, it may be asked how the analytic results mesh with a coach's intuition about what factors are involved in winning, or how a coach and analyst may cooperate in using the results. To this end, an analytics program was started at the University of St. Thomas (UST) in Houston, Texas, to introduce analytics to assist the athletic department to help all coach's improve their respective teams' performance. The first step in this program involves the UST Men's Basketball Team.

The basketball coach for the men's basketball team is Todd Smith (who also serves as the athletic director). Coach Smith has set six objectives for this team to reach each game: less than 10 offensive rebounds for the opponents, draw at least 3 charges, keep the opposition under 65 points, shoot at least 45%, have at least 16 assists, and have less than 12 turnovers. If at least three of these objectives are met, he believes that the team will win at least 90% of games. The objectives are based on Coach Smith's intuition of what he believes are achievable objectives for his team to meet. These objectives and the Coach's hypothesis allows a way for analytics to be introduced for the basketball program.

Thus, the aim of this project is to test Coach Smith's claim that meeting at least three of the objectives will result in winning at least 90% of games. In addition to testing the claim for UST Men's Basketball, this claim will also be examined across the all NAIA men's basketball teams. This project will also see which objectives are most important for both UST and NAIA teams.

2. Background

The University of St. Thomas (UST) Men's Basketball program was discontinued in the mid-eighties, but was restarted and played its first season as a member of the National Association of Intercollegiate Athletics (NAIA) in 2009. The NAIA has two divisions for basketball (men's and women's), and UST plays in Division I. At the Division I level, there were 101 teams spread across ten conferences (including independents) for the 2013-14 season. UST played as an independent for two seasons and has played the last three as a member of the Red River Athletic Conference. The past two seasons have seen UST reach the NAIA national tournament, as a conference tournament champion (2013) and as an at-large team (2014).

3. Data and Methods

3.1 Data

All data used for this project were collected from box scores from the NAIA Official Statistics website, which can be found at http://www.dakstas.com/WebSync/Pages/SportGenders.aspx?association=10&sg=MBB. The box scores for all games played by NAIA Division I teams from the 2009-2010 seasons through the 2013-2014 seasons were scraped from the website.

Since the box scores are known to have errors, quality control was performed. Quality control removed any incomplete box scores or box scores for which there were discrepancies (e.g., box score total points not matching line score totals). Additionally, games for which a team had less than 40 possessions or more than 120 possession were also removed from the data. After excluding games there were 146 total games for UST and 16,453 games for all NAIA teams (including UST).

3.2 Methods

Objectives based on raw box score values and objectives based on adjusted values were used in the analyses. The raw data were adjusted for the analyses using formulas from kenpom.com and data for UST over the five seasons as follows:

Possessions:
Possession were estimated by *POSS=FGA-OR+TO+0.475*FTA*, where FGA = Field Goal Attempts, OR = Offensive Rebounds, TO = Turnovers, and FTA = Free Throw Attempts. Possessions were used to adjust the points and turnover objectives.

Points:
Points were adjusted to Opposition Points per Possession (OPPP). The opponents possessions per game were estimated to be 70. Thus, *OPPP=65/70=0.929*.

Offensive Rebounds:
Offensive rebounds were adjusted to offensive rebounding percentage:
OR%=OR/(OR+DR)
To calculate the *OR%*, 34 offensive rebounding opportunities per game was used. Thus, the offensive rebounds objective was converted to *OR%=10/34=0.294*.

Turnovers:
Turnovers were adjusted to turnovers per possession. Thus TO/POSS=12/70=0.171.

Assists:
Assists were adjusted to an assist rate: *AST Rate=Assists/Field Goals Made (FGM).*
The assist rate used was *AST Rate=16/25=0.64*, where 25 is the rounded average
number of field goals made by UST over the 5 seasons.

Field Goal Percentage:
Field Goal Percentage (FG%) was kept at 45%.

To test the coach's hypothesis, one proportion z-tests were performed using the raw box
score data for UST, and adjusted values were used to test the hypothesis for UST and all
NAIA teams. All analyses and data collection were done using R Statistical Software,
including the XML and stringr packages.

4. Results

The results for UST using the raw box score numbers are in Table 1. UST met at least
three of the five objectives in 63 of the 146 games and won 79.4% of those games. This is
significantly less than the hypothesized win percentage of at least 90% (p=0.002).
Meeting at least three objectives accounts for 56.8% of the total wins over the five
seasons (50 of 88 total wins). UST met four or five of the objectives 17 times, winning 16
of the games, including all six when five objectives were met.

Table 1: UST meeting three or more objectives using raw box score values (*p = 0.002
for 3+ objectives)

| | By Season | | | | | | | | |
| | 3+ objectives | | | 4+ objectives | | | 5 objectives | | |
	W	L	%	W	L	%	W	L	%
2009-10	5	0	100	1	0	100	1	0	100
2010-11	5	3	62.5	2	1	66.7	1	0	100
2011-12	11	6	64.7	4	0	100	1	0	100
2012-13	15	3	83.3	6	0	100	2	0	100
2013-14	11	1	91.7	3	0	100	1	0	100
*Overall**	50	13	79.4	16	1	94.1	6	0	100

Using the adjusted values for the objectives (Table 2), UST met at least three objectives
in 54 games, winning 52 (96.2%). This lends support to the coach's intuition as we
cannot reject his hypothesis that the winning percentage is at least 90% (p = 0.938).
Meeting these adjusted objectives accounts for 59.1% of the 88 wins. When UST met at
least four of the objectives, they won 19 out of the 20 games. Examining the data for all
NAIA teams using the adjusted objectives, meeting at least three of the five objectives
resulted in a winning 90.3% of games (Table 3). This also lends support the coach's
intuition (p = 0.773). The 4011 wins when meeting at least three of the five objectives
accounted for 45.6% of the 8795 total wins by all NAIA teams over the 5 seasons. When
meeting at least four of the objectives, NAIA teams won 98% of games.

Table 2: UST meeting three or more objectives using adjusted values
(*p=0.938 for 3+ objectives)

By Season

	3+ objectives			4+ objectives			5 objectives		
	W	L	%	W	L	%	W	L	%
2009-10	5	0	100	2	0	100	0	0	N/A
2010-11	5	0	100	2	0	100	0	0	N/A
2011-12	10	1	90.9	4	1	80	1	0	100
2012-13	18	0	100	6	0	100	2	0	100
2013-14	14	1	93.3	5	0	100	1	0	100
*Overall**	52	2	96.2	19	1	94.1	6	0	100

Table 3: NAIA teams meeting three or more objectives using adjusted values (*p=0.773 for 3+ objectives)

By Season

	3+ objectives			4+ objectives			5 objectives		
	W	L	%	W	L	%	W	L	%
2009-10	838	77	91.6	275	4	98.6	34	0	100
2010-11	864	93	90.3	264	8	97.1	29	0	100
2011-12	847	67	92.7	261	6	97.8	33	0	100
2012-13	716	69	91.2	236	2	99.2	31	0	100
2013-14	746	123	85.8	233	6	97.5	28	0	100
*Overall**	4011	429	90.3	1269	26	98.0	155	0	100

In examining each objective alone, Opponents Points per Possession results in the highest winning percentage for both UST and NAIA teams when only one objective is met, 42.8% and 58.8% respectively (Table 4). Field Goal Percentage was the next highest in winning percentage at 33.3% for UST and 44.8% for all NAIA teams. When at least both OPPP and FG% objectives were met, UST won all 30 games while all NAIA teams won 97.2% of games, which accounted for 34.1% and 37.4% of all wins respectively.(Table 5)

Table 4: Wins/Losses when only meeting one objective

	UST			NAIA		
Objectives	W	L	PCT	W	L	PCT
OPPP	3	4	42.8	479	335	58.8
FG%	2	4	33.3	724	891	44.8
Opp. ORB%	1	4	20	111	955	10.4
TO/Poss	1	8	11.1	180	838	17.7
Assist Rate	0	4	0	43	309	12.2
Total	7	24	29.2	1537	3328	46.2

Table 5: Wins/Losses meeting both OPPP and FG% objectives and other objectives

	UST				NAIA		
# obj	W	L	PCT	# obj	W	L	PCT
2	4	0	100	2	695	50	93.3
3	13	0	100	3	1489	39	97.4
4	9	0	100	4	948	4	99.6
5	4	0	100	5	155	0	100
TOTAL	30	0	100	TOTAL	3287	93	97.2

When the OPPP objective was raised to one or less, the winning percentages decreased, but the proportion of wins accounted for increased. For UST, meeting at least three objectives with OPPP < 1 resulted in a winning percentage of 90.9%, and accounted for 68.1% of wins, while for NAIA teams, the winning percentage was 87.5% which accounted for 52.3% of wins. When lowering the FG% objective to 40%, UST won 92.5% of games when meeting at least three objectives which accounted for 70.4% of wins; for NAIA teams, the winning percentage was 85.1% which accounted for 54.0% of wins.(Tables 6 and 7).

Table 6: Wins/Losses with OPPP < 1

	UST					NAIA			
# obj	W	L	PCT	PCT (adj)	# obj	W	L	PCT	PCT (adj)
0	0	10	0	0	0	45	1474	0.2	7.2
1	5	23	17.9	22.6	1	1084	3172	25.5	31.6
2	23	19	54.8	59.2	2	2972	2345	55.9	60.8
3	39	5	88.6	97.1	3	3130	615	83.6	87.2
4	16	1	94.1	93.8	4	1375	51	96.4	97.7
5	5	0	100	100	5	189	1	99.5	100
TOT	88	58	60.3		TOT	8975	7658	53.5	
3+ obj	60	6	90.9	100	3+ obj	4694	667	87.5	95.6

Table 7: Wins/Losses with FG% $\geq$ 40%

	UST					NAIA			
# obj	W	L	PCT	PCT (OPPP<1)	# obj	W	L	PCT	PCT (OPPP<1)
0	0	7	0	0	0	23	1094	2	0.2
1	4	22	15.4	17.9	1	1081	3187	25.3	25.5
2	22	24	47.8	54.8	2	2848	2533	52.9	55.9
3	34	3	91.9	88.6	3	3193	787	80.2	83.6
4	22	2	91.7	94.1	4	1447	57	96.2	96.4
5	6	0	100	100	5	203	0	100	99.5
TOT	88	58	60.3		TOT	8975	7658	53.5	
3+ obj	62	5	92.5	90.9	3+ obj	4843	844	85.1	87.5

Looking at each objective alone, the winning percentages are lower for OPPP only or FG% = 40% only (25.0% and 11.1% for UST and 25.6% and 22.4% for NAIA teams). Using OPPP < 1 and FG% = 40% and keeping the other values for the objectives the same, UST wins 91.0% of games when at least three objectives are met, while NAIA teams win 63.3% of games. Using these objectives, meeting three or more accounts for 80.7% of wins for UST and 63.3% of wins for NAIA teams. When both objectives are met, the winning percentages for UST and NAIA teams are 95.1% and 90.7% respectively when meeting at least three of the objectives.(Tables 8 and 9)

Table 8: Wins/Losses meeting individual criteria with OPPP < 1 and FG% $\geq$ 40%

	UST				NAIA			
Objectives	W	L	PCT	PCT (adj)	W	L	PCT	PCT (adj)
OPPP	2	6	25	42.8	181	525	25.6	58.8
FG%	1	8	11.1	33.3	413	1434	22.4	44.8
Opp. ORB%	0	2	0	20	0	339	0	10.4
TO/Poss	0	4	0	11.1	10	456	2.1	17.7
Assist Rate	0	1	0	0	1	126	0.1	12.2
Total	3	21	12.5	29.2	605	2880	17.3	46.2

Table 9: Wins/Losses meeting both OPPP < 1 and FG% ≤ 40% + other objectives

# obj	UST W	L	PCT	# obj	NAIA W	L	PCT
2	6	1	85.7	2	1145	392	74.5
3	32	1	97	3	2806	405	87.4
4	19	2	90.5	4	1669	75	95.7
5	7	0	100	5	257	4	98.5
TOTAL	64	4	94.2	TOTAL	5877	876	87.8
3+ obj	58	3	95.1	3+ obj	4732	484	90.7

5. Conclusions

Using raw box score data, it was found that meeting at least three of Coach Smith's objectives(less than 65 points for the opposition, less than 10 rebounds for the opposition, shooting at least 45%, less than 12 turnovers, and at least 16 assists), resulted in UST winning 79.4% of games, significantly lower than the 90% he hypothesized. However, when adjusting the values, the winning percentage was 96.2% for UST, which supports his intuition. When looking at all NAIA teams, the winning percentage was 90.3%, furthering support for his intuition.

The most important objectives for both UST and NAIA teams were Opponents Points per Possession (OPPP) and Field Goal Percentage (FG%), with OPPP being the most important. When UST met both objectives they won all games, while NAIA teams won 97.2% of games. When changing the objectives to OPPP < 1 and FG% ≥ 40%, decreased the percentages; however, more wins were accounted for.

The six objectives can also be examined with Dean Oliver's Four Factors – field goal percentage, offensive rebounding, turnovers and free throw frequency. Oliver has shown that doing three of these well on offense lead to consistently winning; these factors can also be applied defensively as well. The field goal percentage and opponents points per possession were shown to be the most important of Coach Smith's objectives. The average field goal percentage for NAIA teams during the five seasons examined was 44.7%, while the objective was 45% -- this reflects Oliver's Factor of shooting a high field goal percentage. OPPP may also be indicative of defensive field goal percentage, as a lower defensive field goal percentage may lower the points per possession.

While Smith and Oliver also emphasize offensive rebounding, this was not as much of a contributor to winning for UST. This may be due to the fact that the objective may be too restrictive and that a higher OR% may not diminish the chances of winning. The same can be concluded regarding turnovers. While there may not be a comparable factor of Oliver's for assists, this may be reflected in field goal percentage.

While the data do support Coach Smith's hypothesis that meeting three of his objectives results in winning at least 90% of games, this percentage could change if the number of charges per game could be tracked. Since UST started tracking charges per game during the 2013-2014 season, going forward this can be added to future analyses. Also, since

more NAIA teams are posting play-by-play information, this may be used to track charges. Finally, in addition to adding data from upcoming seasons, the optimal values for the objectives may be different that the values set out by Coach Smith. Finding these optimal values based on UST's past games and during the season may help Coach Smith with setting the goals for his team.

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