Situational Underlying Value (SUV) – A Single Statistic For Individual Performance In Professional Football And NCAA Men's Division I Basketball

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Abstract- The concept of the Situational Underlying Value (SUV) statistic has been introduced in connection with major league baseball, based on the "run expectancy" associated with each base and number of outs. Having completed that development, including the "proof of principle" for one-third of one team's entire season (54 of 162 games), the SUV has been extended to both professional football (National Football League) and NCAA Men's Division I College Basketball. The development for the SUV in these two sports is described in this article, including a similar "proof of principle" which analyzes one-third of an NFL team's regular season (five of 16 games) and five games for one team in the NCAA Division I Men's Basketball Championship. The SUV version for football takes advantage of previous analyses which attribute point values to each field position based on the down and number of "yards to go." The basketball version develops its SUV from "first principles," based on statistics from an entire season of NCAA Division I Men's Basketball. As with baseball, the SUV statistics for football and basketball proved to be functional in measuring individual player performance via one overarching statistic. Results from the "Proof of Principle" exercises showed very good agreement with traditional statistics for football while uncovering some possibly unique insights that would lead to different conclusions in basketball from traditional statistics.

Index Terms- Positional Point Values, Football, Basketball, Season Statistics

I.INTRODUCTION

SUV for professional football (National Football League [NFL]) is not as readily conceived as that for baseball (References 1-4), although the concept of each position on the field with down and yards to go has been examined for the possibility of assigning point values (from here on referred to as SUVs). Quantification of this concept is taken from Reference 5:

Every spot on the field has an abstract value in terms of points. We can begin assigning values at the end zones, where having the ball has a clear and concrete value. Possessing the ball at the opponent's end zone is worth (nearly always) 7 points. And having the ball at your own end zone is worth -2 points. Every other yard line has a point value too. We can measure it by averaging how many points will be scored next … The concept of point expectancy originated with the work of Virgil Carter, a former NFL quarterback who studied operations research in the early 1970s (while an active player). Carroll, Palmer, and Thorn adapted the concept in their 1987 book The Hidden Game of Football … The graph below [see Figure 1] *plots the expected points for a 1st down at each yard line. For simplicity, I've named each yard line in terms of its distance from an opponent's end zone. Having the ball at one's own 20 is "the 80 yard line" for example.*

This was readily linearized into segments based on the following values assumed for field position and expected points from the chart: (1, 6.5), (4, 5.6), (10, 5), (35, 3), (93, -0.5), (98, -1) and (99, -1.4). When plotted, this piecewise linear function appears as in Figure 2. To adjust for 2nd and 3rd downs, Burke recommends the following:

Things become more complicated when we consider other down and distance situations. Suppose at any given yard line, a pass falls incomplete on 1st and 10. Second down and 10 represents a drop off of about 0.5 points expected. Second and 9 represents a slightly smaller drop off, until at about 2nd and 5 when the expected points are approximately equal to those for 1st and 10. This is consistent with the 1st down probability method I described in my previous posts. Third down and 10 represents a further drop off of about 0.5 points.

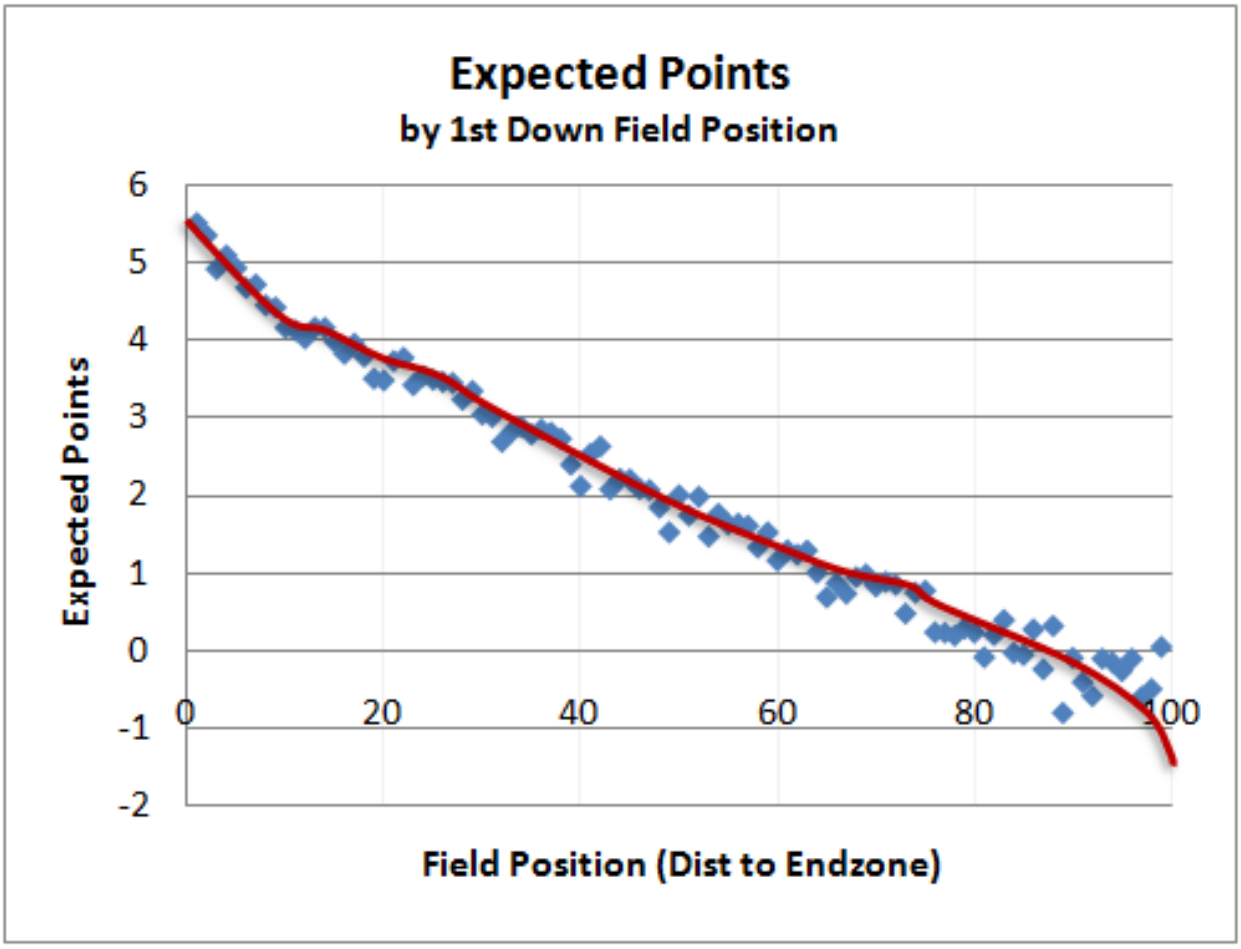

Figure 1. Expected Points by First Down Field Position (See Reference 5)

II.SUV Football: Tables based on Down, Yards to Go and Field Position

Based on the fitted curve and Burke's recommended adjustments for 2nd and 3rd down, I compiled the following SUVs for all field positions for 1st, 2nd and 3rd down with 10 or less yards to go. Note that, after decreasing the SUV for 1st and 10 by Burke's recommended 0.5, I increased each SUV by 0.1 as the yards to go decreased from 10 to five. For five or less, I assumed a constant equal to 1st and 10. I did likewise for 3rd downs, with 3rd and 10 0.5 less than 2nd and 10 down to 3rd and five (or less) being the same as 2nd and 10. The results are shown in Table 1. They are immediately followed by results for more than 10 yards to go. For these, I assumed a 0.1 decrease by yard up to 20 yards, which I then treated as constant for anything higher. These are shown in Table 2 for 1st down only – to keep the number and length of tables tractable, the tables for 2nd and 3rd down for more than 10 yards to go can be extrapolated from Table 2 (or viewed directly in Reference 1).

A. SUVs for Fourth Down

Guidance for 4th down was more difficult to find and develop into an SUV. For this, two articles (References 6 and 7) provided information. The first article provided the chart in Figure 3, recommending what to choose on 4th down, on which I superimposed line segments representing the boundaries between going for it vs. other. The line segments connected at the following values for field position and yards to go: (99, 2), (76, 2), (61, 4), (38, 10.5), (32, 7), (21, 3), (12, 3), (4, 4). The second article provided the following information:

Figure 2.

Expected Points by First Down Field Position - Linearized from Table 1

Going for it on 4th-and-short has had a 62.7% success rate over the last three years [2010-2012] *... There is a noticeable dip in the 2011 data: 2010 and 2012 look alike and suggest an over 66% (2 out of 3) conversion rate ... The year-to-year data sets are small enough to allow for this kind of fluctuation. It is best to assume that the "real" success rate lies between the low of 2011 and the high of the other two years, though we will see later that there are compelling reasons to lean toward the higher rate ... The raw data tells us that 4th-and-short conversion attempts are not a high-risk gamble. A 63% success rate represents good odds. ... That stability is the most interesting finding of this study. The 62.7% success rate we started with is much closer to 66.7%, or two-thirds, if a few more dire circumstance attempts are teased out ... [I]f a team goes for it on 4th-and-short three times in a game, they are statistically likely to gain two 1st downs and turn the ball over on downs once. If the team makes those three attempts at, say, the opponent's 40-yard line, that means they will get the ball in scoring position twice but give the opponent good field position once.*

Table 1. SUVs for Field Positions with Ten or Less "Yards to Go"

yd	pt (1/10-)	pt (2/10)	pt (2/9)	pt (2/8)	pt (2/7)	pt (2/6)	pt (2/5-)	pt (3/10)	pt (3/9)	pt (3/8)	pt (3/7)	pt (3/6)	pt (3/5-)
1	**6.50**	6.00	6.10	6.20	6.30	6.40	**6.50**	5.50	5.60	5.70	5.80	5.90	**6.00**
2	**6.20**	5.70	5.80	5.90	6.00	6.10	**6.20**	5.20	5.30	5.40	5.50	5.60	**5.70**
3	**5.90**	5.40	5.50	5.60	5.70	5.80	**5.90**	4.90	5.00	5.10	5.20	5.30	**5.40**
4	**5.60**	5.10	5.20	5.30	5.40	5.50	**5.60**	4.60	4.70	4.80	4.90	5.00	**5.10**
5	**5.50**	5.00	5.10	5.20	5.30	5.40	**5.50**	4.50	4.60	4.70	4.80	4.90	**5.00**
6	**5.40**	4.90	5.00	5.10	5.20	5.30	**5.40**	4.40	4.50	4.60	4.70	4.80	**4.90**
7	**5.30**	4.80	4.90	5.00	5.10	5.20	**5.30**	4.30	4.40	4.50	4.60	4.70	**4.80**
8	**5.20**	4.70	4.80	4.90	5.00	5.10	**5.20**	4.20	4.30	4.40	4.50	4.60	**4.70**
9	**5.10**	4.60	4.70	4.80	4.90	5.00	**5.10**	4.10	4.20	4.30	4.40	4.50	**4.60**
10	**5.00**	4.50	4.60	4.70	4.80	4.90	**5.00**	4.00	4.10	4.20	4.30	4.40	**4.50**
11	**4.92**	4.42	4.52	4.62	4.72	4.82	**4.92**	3.92	4.02	4.12	4.22	4.32	**4.42**
12	**4.84**	4.34	4.44	4.54	4.64	4.74	**4.84**	3.84	3.94	4.04	4.14	4.24	**4.34**
13	**4.76**	4.26	4.36	4.46	4.56	4.66	**4.76**	3.76	3.86	3.96	4.06	4.16	**4.26**
14	**4.68**	4.18	4.28	4.38	4.48	4.58	**4.68**	3.68	3.78	3.88	3.98	4.08	**4.18**
15	**4.60**	4.10	4.20	4.30	4.40	4.50	**4.60**	3.60	3.70	3.80	3.90	4.00	**4.10**
16	**4.52**	4.02	4.12	4.22	4.32	4.42	**4.52**	3.52	3.62	3.72	3.82	3.92	**4.02**
17	**4.44**	3.94	4.04	4.14	4.24	4.34	**4.44**	3.44	3.54	3.64	3.74	3.84	**3.94**
18	**4.36**	3.86	3.96	4.06	4.16	4.26	**4.36**	3.36	3.46	3.56	3.66	3.76	**3.86**
19	**4.28**	3.78	3.88	3.98	4.08	4.18	**4.28**	3.28	3.38	3.48	3.58	3.68	**3.78**
20	**4.20**	3.70	3.80	3.90	4.00	4.10	**4.20**	3.20	3.30	3.40	3.50	3.60	**3.70**
21	**4.12**	3.62	3.72	3.82	3.92	4.02	**4.12**	3.12	3.22	3.32	3.42	3.52	**3.62**
22	**4.04**	3.54	3.64	3.74	3.84	3.94	**4.04**	3.04	3.14	3.24	3.34	3.44	**3.54**
23	**3.96**	3.46	3.56	3.66	3.76	3.86	**3.96**	2.96	3.06	3.16	3.26	3.36	**3.46**
24	**3.88**	3.38	3.48	3.58	3.68	3.78	**3.88**	2.88	2.98	3.08	3.18	3.28	**3.38**
25	**3.80**	3.30	3.40	3.50	3.60	3.70	**3.80**	2.80	2.90	3.00	3.10	3.20	**3.30**
26	**3.72**	3.22	3.32	3.42	3.52	3.62	**3.72**	2.72	2.82	2.92	3.02	3.12	**3.22**
27	**3.64**	3.14	3.24	3.34	3.44	3.54	**3.64**	2.64	2.74	2.84	2.94	3.04	**3.14**
28	**3.56**	3.06	3.16	3.26	3.36	3.46	**3.56**	2.56	2.66	2.76	2.86	2.96	**3.06**
29	**3.48**	2.98	3.08	3.18	3.28	3.38	**3.48**	2.48	2.58	2.68	2.78	2.88	**2.98**
30	**3.40**	2.90	3.00	3.10	3.20	3.30	**3.40**	2.40	2.50	2.60	2.70	2.80	**2.90**
31	**3.32**	2.82	2.92	3.02	3.12	3.22	**3.32**	2.32	2.42	2.52	2.62	2.72	**2.82**

yd	pt (1/10-)	pt (2/10)	pt (2/9)	pt (2/8)	pt (2/7)	pt (2/6)	pt (2/5-)	pt (3/10)	pt (3/9)	pt (3/8)	pt (3/7)	pt (3/6)	pt (3/5-)
32	**3.24**	2.74	2.84	2.94	3.04	3.14	**3.24**	2.24	2.34	2.44	2.54	2.64	**2.74**
33	**3.16**	2.66	2.76	2.86	2.96	3.06	**3.16**	2.16	2.26	2.36	2.46	2.56	**2.66**
34	**3.08**	2.58	2.68	2.78	2.88	2.98	**3.08**	2.08	2.18	2.28	2.38	2.48	**2.58**
35	**3.00**	2.50	2.60	2.70	2.80	2.90	**3.00**	2.00	2.10	2.20	2.30	2.40	**2.50**
36	**2.94**	2.44	2.54	2.64	2.74	2.84	**2.94**	1.94	2.04	2.14	2.24	2.34	**2.44**
37	**2.88**	2.38	2.48	2.58	2.68	2.78	**2.88**	1.88	1.98	2.08	2.18	2.28	**2.38**
38	**2.82**	2.32	2.42	2.52	2.62	2.72	**2.82**	1.82	1.92	2.02	2.12	2.22	**2.32**
39	**2.76**	2.26	2.36	2.46	2.56	2.66	**2.76**	1.76	1.86	1.96	2.06	2.16	**2.26**
40	**2.70**	2.20	2.30	2.40	2.50	2.60	**2.70**	1.70	1.80	1.90	2.00	2.10	**2.20**
41	**2.64**	2.14	2.24	2.34	2.44	2.54	**2.64**	1.64	1.74	1.84	1.94	2.04	**2.14**
42	**2.58**	2.08	2.18	2.28	2.38	2.48	**2.58**	1.58	1.68	1.78	1.88	1.98	**2.08**
43	**2.52**	2.02	2.12	2.22	2.32	2.42	**2.52**	1.52	1.62	1.72	1.82	1.92	**2.02**
44	**2.46**	1.96	2.06	2.16	2.26	2.36	**2.46**	1.46	1.56	1.66	1.76	1.86	**1.96**
45	**2.40**	1.90	2.00	2.10	2.20	2.30	**2.40**	1.40	1.50	1.60	1.70	1.80	**1.90**
46	**2.34**	1.84	1.94	2.04	2.14	2.24	**2.34**	1.34	1.44	1.54	1.64	1.74	**1.84**
47	**2.28**	1.78	1.88	1.98	2.08	2.18	**2.28**	1.28	1.38	1.48	1.58	1.68	**1.78**
48	**2.22**	1.72	1.82	1.92	2.02	2.12	**2.22**	1.22	1.32	1.42	1.52	1.62	**1.72**
49	**2.16**	1.66	1.76	1.86	1.96	2.06	**2.16**	1.16	1.26	1.36	1.46	1.56	**1.66**
50	**2.09**	1.59	1.69	1.79	1.89	1.99	**2.09**	1.09	1.19	1.29	1.39	1.49	**1.59**
51	**2.03**	1.53	1.63	1.73	1.83	1.93	**2.03**	1.03	1.13	1.23	1.33	1.43	**1.53**
52	**1.97**	1.47	1.57	1.67	1.77	1.87	**1.97**	0.97	1.07	1.17	1.27	1.37	**1.47**
53	**1.91**	1.41	1.51	1.61	1.71	1.81	**1.91**	0.91	1.01	1.11	1.21	1.31	**1.41**
54	**1.85**	1.35	1.45	1.55	1.65	1.75	**1.85**	0.85	0.95	1.05	1.15	1.25	**1.35**
55	**1.79**	1.29	1.39	1.49	1.59	1.69	**1.79**	0.79	0.89	0.99	1.09	1.19	**1.29**
56	**1.73**	1.23	1.33	1.43	1.53	1.63	**1.73**	0.73	0.83	0.93	1.03	1.13	**1.23**
57	**1.67**	1.17	1.27	1.37	1.47	1.57	**1.67**	0.67	0.77	0.87	0.97	1.07	**1.17**
58	**1.61**	1.11	1.21	1.31	1.41	1.51	**1.61**	0.61	0.71	0.81	0.91	1.01	**1.11**
59	**1.55**	1.05	1.15	1.25	1.35	1.45	**1.55**	0.55	0.65	0.75	0.85	0.95	**1.05**

yd	pt (1/10-)	pt (2/10)	pt (2/9)	pt (2/8)	pt (2/7)	pt (2/6)	pt (2/5-)	pt (3/10)	pt (3/9)	pt (3/8)	pt (3/7)	pt (3/6)	pt (3/5-)
60	1.49	0.99	1.09	1.19	1.29	1.39	1.49	0.49	0.59	0.69	0.79	0.89	0.99
61	1.43	0.93	1.03	1.13	1.23	1.33	1.43	0.43	0.53	0.63	0.73	0.83	0.93
62	1.37	0.87	0.97	1.07	1.17	1.27	1.37	0.37	0.47	0.57	0.67	0.77	0.87
63	1.31	0.81	0.91	1.01	1.11	1.21	1.31	0.31	0.41	0.51	0.61	0.71	0.81
64	1.25	0.75	0.85	0.95	1.05	1.15	1.25	0.25	0.35	0.45	0.55	0.65	0.75
65	1.19	0.69	0.79	0.89	0.99	1.09	1.19	0.19	0.29	0.39	0.49	0.59	0.69
66	1.13	0.63	0.73	0.83	0.93	1.03	1.13	0.13	0.23	0.33	0.43	0.53	0.63
67	1.07	0.57	0.67	0.77	0.87	0.97	1.07	0.07	0.17	0.27	0.37	0.47	0.57
68	1.01	0.51	0.61	0.71	0.81	0.91	1.01	0.01	0.11	0.21	0.31	0.41	0.51
69	0.95	0.45	0.55	0.65	0.75	0.85	0.95	-0.05	0.05	0.15	0.25	0.35	0.45
70	0.89	0.39	0.49	0.59	0.69	0.79	0.89	-0.11	-0.01	0.09	0.19	0.29	0.39
71	0.83	0.33	0.43	0.53	0.63	0.73	0.83	-0.17	-0.07	0.03	0.13	0.23	0.33
72	0.77	0.27	0.37	0.47	0.57	0.67	0.77	-0.23	-0.13	-0.03	0.07	0.17	0.27
73	0.71	0.21	0.31	0.41	0.51	0.61	0.71	-0.29	-0.19	-0.09	0.01	0.11	0.21
74	0.65	0.15	0.25	0.35	0.45	0.55	0.65	-0.35	-0.25	-0.15	-0.05	0.05	0.15
75	0.59	0.09	0.19	0.29	0.39	0.49	0.59	-0.41	-0.31	-0.21	-0.11	-0.01	0.09
76	0.53	0.03	0.13	0.23	0.33	0.43	0.53	-0.47	-0.37	-0.27	-0.17	-0.07	0.03
77	0.47	-0.03	0.07	0.17	0.27	0.37	0.47	-0.53	-0.43	-0.33	-0.23	-0.13	-0.03
78	0.41	-0.09	0.01	0.11	0.21	0.31	0.41	-0.59	-0.49	-0.39	-0.29	-0.19	-0.09
79	0.34	-0.16	-0.06	0.04	0.14	0.24	0.34	-0.66	-0.56	-0.46	-0.36	-0.26	-0.16
80	0.28	-0.22	-0.12	-0.02	0.08	0.18	0.28	-0.72	-0.62	-0.52	-0.42	-0.32	-0.22
81	0.22	-0.28	-0.18	-0.08	0.02	0.12	0.22	-0.78	-0.68	-0.58	-0.48	-0.38	-0.28
82	0.16	-0.34	-0.24	-0.14	-0.04	0.06	0.16	-0.84	-0.74	-0.64	-0.54	-0.44	-0.34
83	0.10	-0.40	-0.30	-0.20	-0.10	0.00	0.10	-0.90	-0.80	-0.70	-0.60	-0.50	-0.40
84	0.04	-0.46	-0.36	-0.26	-0.16	-0.06	0.04	-0.96	-0.86	-0.76	-0.66	-0.56	-0.46
85	-0.02	-0.52	-0.42	-0.32	-0.22	-0.12	-0.02	-1.02	-0.92	-0.82	-0.72	-0.62	-0.52
86	-0.08	-0.58	-0.48	-0.38	-0.28	-0.18	-0.08	-1.08	-0.98	-0.88	-0.78	-0.68	-0.58
87	-0.14	-0.64	-0.54	-0.44	-0.34	-0.24	-0.14	-1.14	-1.04	-0.94	-0.84	-0.74	-0.64

yd	pt (1/10-)	pt (2/10)	pt (2/9)	pt (2/8)	pt (2/7)	pt (2/6)	pt (2/5-)	pt (3/10)	pt (3/9)	pt (3/8)	pt (3/7)	pt (3/6)	pt (3/5-)
88	**-0.20**	-0.70	-0.60	-0.50	-0.40	-0.30	**-0.20**	-1.20	-1.10	-1.00	-0.90	-0.80	**-0.70**
89	**-0.26**	-0.76	-0.66	-0.56	-0.46	-0.36	**-0.26**	-1.26	-1.16	-1.06	-0.96	-0.86	**-0.76**
90	**-0.32**	-0.82	-0.72	-0.62	-0.52	-0.42	**-0.32**	-1.32	-1.22	-1.12	-1.02	-0.92	**-0.82**
91	**-0.38**	-0.88	-0.78	-0.68	-0.58	-0.48	**-0.38**	-1.38	-1.28	-1.18	-1.08	-0.98	**-0.88**
92	**-0.44**	-0.94	-0.84	-0.74	-0.64	-0.54	**-0.44**	-1.44	-1.34	-1.24	-1.14	-1.04	**-0.94**
93	**-0.50**	-1.00	-0.90	-0.80	-0.70	-0.60	**-0.50**	-1.50	-1.40	-1.30	-1.20	-1.10	**-1.00**
94	**-0.60**	-1.10	-1.00	-0.90	-0.80	-0.70	**-0.60**	-1.60	-1.50	-1.40	-1.30	-1.20	**-1.10**
95	**-0.70**	-1.20	-1.10	-1.00	-0.90	-0.80	**-0.70**	-1.70	-1.60	-1.50	-1.40	-1.30	**-1.20**
96	**-0.80**	-1.30	-1.20	-1.10	-1.00	-0.90	**-0.80**	-1.80	-1.70	-1.60	-1.50	-1.40	**-1.30**
97	**-0.90**	-1.40	-1.30	-1.20	-1.10	-1.00	**-0.90**	-1.90	-1.80	-1.70	-1.60	-1.50	**-1.40**
98	**-1.00**	-1.50	-1.40	-1.30	-1.20	-1.10	**-1.00**	-2.00	-1.90	-1.80	-1.70	-1.60	**-1.50**
99	**-1.40**	-1.90	-1.80	-1.70	-1.60	-1.50	**-1.40**	-2.40	-2.30	-2.20	-2.10	-2.00	**-1.90**

Table 2. SUVs for Field Positions – First Down with More than Ten "Yards to Go"

yd	pt (1/10-)	pt (1/11)	pt (1/12)	pt (1/13)	pt (1/14)	pt (1/15)	pt (1/16)	pt (1/17)	pt (1/18)	pt (1/19)	pt (1/20+)
1	**6.50**	6.40	6.30	6.20	6.10	6.00	5.90	5.80	5.70	5.60	5.50
2	**6.20**	6.10	6.00	5.90	5.80	5.70	5.60	5.50	5.40	5.30	5.20
3	**5.90**	5.80	5.70	5.60	5.50	5.40	5.30	5.20	5.10	5.00	4.90
4	**5.60**	5.50	5.40	5.30	5.20	5.10	5.00	4.90	4.80	4.70	4.60
5	**5.50**	5.40	5.30	5.20	5.10	5.00	4.90	4.80	4.70	4.60	4.50
6	**5.40**	5.30	5.20	5.10	5.00	4.90	4.80	4.70	4.60	4.50	4.40
7	**5.30**	5.20	5.10	5.00	4.90	4.80	4.70	4.60	4.50	4.40	4.30
8	**5.20**	5.10	5.00	4.90	4.80	4.70	4.60	4.50	4.40	4.30	4.20
9	**5.10**	5.00	4.90	4.80	4.70	4.60	4.50	4.40	4.30	4.20	4.10
10	**5.00**	4.90	4.80	4.70	4.60	4.50	4.40	4.30	4.20	4.10	4.00
11	**4.92**	4.82	4.72	4.62	4.52	4.42	4.32	4.22	4.12	4.02	3.92
12	**4.84**	4.74	4.64	4.54	4.44	4.34	4.24	4.14	4.04	3.94	3.84
13	**4.76**	4.66	4.56	4.46	4.36	4.26	4.16	4.06	3.96	3.86	3.76
14	**4.68**	4.58	4.48	4.38	4.28	4.18	4.08	3.98	3.88	3.78	3.68
15	**4.60**	4.50	4.40	4.30	4.20	4.10	4.00	3.90	3.80	3.70	3.60
16	**4.52**	4.42	4.32	4.22	4.12	4.02	3.92	3.82	3.72	3.62	3.52
17	**4.44**	4.34	4.24	4.14	4.04	3.94	3.84	3.74	3.64	3.54	3.44
18	**4.36**	4.26	4.16	4.06	3.96	3.86	3.76	3.66	3.56	3.46	3.36
19	**4.28**	4.18	4.08	3.98	3.88	3.78	3.68	3.58	3.48	3.38	3.28
20	**4.20**	4.10	4.00	3.90	3.80	3.70	3.60	3.50	3.40	3.30	3.20
21	**4.12**	4.02	3.92	3.82	3.72	3.62	3.52	3.42	3.32	3.22	3.12
22	**4.04**	3.94	3.84	3.74	3.64	3.54	3.44	3.34	3.24	3.14	3.04
23	**3.96**	3.86	3.76	3.66	3.56	3.46	3.36	3.26	3.16	3.06	2.96
24	**3.88**	3.78	3.68	3.58	3.48	3.38	3.28	3.18	3.08	2.98	2.88
25	**3.80**	3.70	3.60	3.50	3.40	3.30	3.20	3.10	3.00	2.90	2.80
26	**3.72**	3.62	3.52	3.42	3.32	3.22	3.12	3.02	2.92	2.82	2.72
27	**3.64**	3.54	3.44	3.34	3.24	3.14	3.04	2.94	2.84	2.74	2.64

yd	pt (1/10-)	pt (1/11)	pt (1/12)	pt (1/13)	pt (1/14)	pt (1/15)	pt (1/16)	pt (1/17)	pt (1/18)	pt (1/19)	pt (1/20+)
28	3.56	3.46	3.36	3.26	3.16	3.06	2.96	2.86	2.76	2.66	2.56
29	3.48	3.38	3.28	3.18	3.08	2.98	2.88	2.78	2.68	2.58	2.48
30	3.40	3.30	3.20	3.10	3.00	2.90	2.80	2.70	2.60	2.50	2.40
31	3.32	3.22	3.12	3.02	2.92	2.82	2.72	2.62	2.52	2.42	2.32
32	3.24	3.14	3.04	2.94	2.84	2.74	2.64	2.54	2.44	2.34	2.24
33	3.16	3.06	2.96	2.86	2.76	2.66	2.56	2.46	2.36	2.26	2.16
34	3.08	2.98	2.88	2.78	2.68	2.58	2.48	2.38	2.28	2.18	2.08
35	3.00	2.90	2.80	2.70	2.60	2.50	2.40	2.30	2.20	2.10	2.00
36	2.94	2.84	2.74	2.64	2.54	2.44	2.34	2.24	2.14	2.04	1.94
37	2.88	2.78	2.68	2.58	2.48	2.38	2.28	2.18	2.08	1.98	1.88
38	2.82	2.72	2.62	2.52	2.42	2.32	2.22	2.12	2.02	1.92	1.82
39	2.76	2.66	2.56	2.46	2.36	2.26	2.16	2.06	1.96	1.86	1.76
40	2.70	2.60	2.50	2.40	2.30	2.20	2.10	2.00	1.90	1.80	1.70
41	2.64	2.54	2.44	2.34	2.24	2.14	2.04	1.94	1.84	1.74	1.64
42	2.58	2.48	2.38	2.28	2.18	2.08	1.98	1.88	1.78	1.68	1.58
43	2.52	2.42	2.32	2.22	2.12	2.02	1.92	1.82	1.72	1.62	1.52
44	2.46	2.36	2.26	2.16	2.06	1.96	1.86	1.76	1.66	1.56	1.46
45	2.40	2.30	2.20	2.10	2.00	1.90	1.80	1.70	1.60	1.50	1.40
46	2.34	2.24	2.14	2.04	1.94	1.84	1.74	1.64	1.54	1.44	1.34
47	2.28	2.18	2.08	1.98	1.88	1.78	1.68	1.58	1.48	1.38	1.28
48	2.22	2.12	2.02	1.92	1.82	1.72	1.62	1.52	1.42	1.32	1.22
49	2.16	2.06	1.96	1.86	1.76	1.66	1.56	1.46	1.36	1.26	1.16
50	2.09	1.99	1.89	1.79	1.69	1.59	1.49	1.39	1.29	1.19	1.09
51	2.03	1.93	1.83	1.73	1.63	1.53	1.43	1.33	1.23	1.13	1.03
52	1.97	1.87	1.77	1.67	1.57	1.47	1.37	1.27	1.17	1.07	0.97
53	1.91	1.81	1.71	1.61	1.51	1.41	1.31	1.21	1.11	1.01	0.91
54	1.85	1.75	1.65	1.55	1.45	1.35	1.25	1.15	1.05	0.95	0.85
55	1.79	1.69	1.59	1.49	1.39	1.29	1.19	1.09	0.99	0.89	0.79
56	1.73	1.63	1.53	1.43	1.33	1.23	1.13	1.03	0.93	0.83	0.73
57	1.67	1.57	1.47	1.37	1.27	1.17	1.07	0.97	0.87	0.77	0.67
58	1.61	1.51	1.41	1.31	1.21	1.11	1.01	0.91	0.81	0.71	0.61
59	1.55	1.45	1.35	1.25	1.15	1.05	0.95	0.85	0.75	0.65	0.55
60	1.49	1.39	1.29	1.19	1.09	0.99	0.89	0.79	0.69	0.59	0.49
61	1.43	1.33	1.23	1.13	1.03	0.93	0.83	0.73	0.63	0.53	0.43
62	1.37	1.27	1.17	1.07	0.97	0.87	0.77	0.67	0.57	0.47	0.37
63	1.31	1.21	1.11	1.01	0.91	0.81	0.71	0.61	0.51	0.41	0.31
64	1.25	1.15	1.05	0.95	0.85	0.75	0.65	0.55	0.45	0.35	0.25
65	1.19	1.09	0.99	0.89	0.79	0.69	0.59	0.49	0.39	0.29	0.19
66	1.13	1.03	0.93	0.83	0.73	0.63	0.53	0.43	0.33	0.23	0.13
67	1.07	0.97	0.87	0.77	0.67	0.57	0.47	0.37	0.27	0.17	0.07
68	1.01	0.91	0.81	0.71	0.61	0.51	0.41	0.31	0.21	0.11	0.01
69	0.95	0.85	0.75	0.65	0.55	0.45	0.35	0.25	0.15	0.05	-0.05
70	0.89	0.79	0.69	0.59	0.49	0.39	0.29	0.19	0.09	-0.01	-0.11
71	0.83	0.73	0.63	0.53	0.43	0.33	0.23	0.13	0.03	-0.07	-0.17
72	0.77	0.67	0.57	0.47	0.37	0.27	0.17	0.07	-0.03	-0.13	-0.23
73	0.71	0.61	0.51	0.41	0.31	0.21	0.11	0.01	-0.09	-0.19	-0.29
74	0.65	0.55	0.45	0.35	0.25	0.15	0.05	-0.05	-0.15	-0.25	-0.35
75	0.59	0.49	0.39	0.29	0.19	0.09	-0.01	-0.11	-0.21	-0.31	-0.41
76	0.53	0.43	0.33	0.23	0.13	0.03	-0.07	-0.17	-0.27	-0.37	-0.47
77	0.47	0.37	0.27	0.17	0.07	-0.03	-0.13	-0.23	-0.33	-0.43	-0.53
78	0.41	0.31	0.21	0.11	0.01	-0.09	-0.19	-0.29	-0.39	-0.49	-0.59
79	0.34	0.24	0.14	0.04	-0.06	-0.16	-0.26	-0.36	-0.46	-0.56	-0.66
80	0.28	0.18	0.08	-0.02	-0.12	-0.22	-0.32	-0.42	-0.52	-0.62	-0.72
81	0.22	0.12	0.02	-0.08	-0.18	-0.28	-0.38	-0.48	-0.58	-0.68	-0.78
82	0.16	0.06	-0.04	-0.14	-0.24	-0.34	-0.44	-0.54	-0.64	-0.74	-0.84

yd	pt (1/10-)	pt (1/11)	pt (1/12)	pt (1/13)	pt (1/14)	pt (1/15)	pt (1/16)	pt (1/17)	pt (1/18)	pt (1/19)	pt (1/20+)
83	**0.10**	0.00	-0.10	-0.20	-0.30	-0.40	-0.50	-0.60	-0.70	-0.80	-0.90
84	**0.04**	-0.06	-0.16	-0.26	-0.36	-0.46	-0.56	-0.66	-0.76	-0.86	-0.96
85	**-0.02**	-0.12	-0.22	-0.32	-0.42	-0.52	-0.62	-0.72	-0.82	-0.92	-1.02
86	**-0.08**	-0.18	-0.28	-0.38	-0.48	-0.58	-0.68	-0.78	-0.88	-0.98	-1.08
87	**-0.14**	-0.24	-0.34	-0.44	-0.54	-0.64	-0.74	-0.84	-0.94	-1.04	-1.14
88	**-0.20**	-0.30	-0.40	-0.50	-0.60	-0.70	-0.80	-0.90	-1.00	-1.10	-1.20
89	**-0.26**	-0.36	-0.46	-0.56	-0.66	-0.76	-0.86	-0.96	-1.06	-1.16	-1.26
90	**-0.32**	-0.42	-0.52	-0.62	-0.72	-0.82	-0.92	-1.02	-1.12	-1.22	-1.32
91	**-0.38**	-0.48	-0.58	-0.68	-0.78	-0.88	-0.98	-1.08	-1.18	-1.28	-1.38
92	**-0.44**	-0.54	-0.64	-0.74	-0.84	-0.94	-1.04	-1.14	-1.24	-1.34	-1.44
93	**-0.50**	-0.60	-0.70	-0.80	-0.90	-1.00	-1.10	-1.20	-1.30	-1.40	-1.50
94	**-0.60**	-0.70	-0.80	-0.90	-1.00	-1.10	-1.20	-1.30	-1.40	-1.50	-1.60
95	**-0.70**	-0.80	-0.90	-1.00	-1.10	-1.20	-1.30	-1.40	-1.50	-1.60	-1.70
96	**-0.80**	-0.90	-1.00	-1.10	-1.20	-1.30	-1.40	-1.50	-1.60	-1.70	-1.80
97	**-0.90**	-1.00	-1.10	-1.20	-1.30	-1.40	-1.50	-1.60	-1.70	-1.80	-1.90
98	**-1.00**	-1.10	-1.20	-1.30	-1.40	-1.50	-1.60	-1.70	-1.80	-1.90	-2.00
99	**-1.40**	-1.50	-1.60	-1.70	-1.80	-1.90	-2.00	-2.10	-2.20	-2.30	-2.40

Based on this discussion, I assumed that the probability of success in "going for it" on 4th and short would be 2/3. However, the "go for it" region in the chart extends beyond two yards over much of its range. While the probability of success for 4th and longer than two yards is surely less than 2/3, in terms of SUV, I assumed that the full "go for it" region could be characterized by an SUV as follows. Starting with the equivalent yardage (and field position) on 4th down, adjust the corresponding SUV for 3rd down by multiplying by 2/3 and then subtracting 1/3 of the SUV for 1st and 10 from that same field position, representing the SUV of the other team should it take over after 4th down. If the 4th down yardage exceeded the "break even" threshold (BET) for the "go for it" region, as indicated by the solid black line superimposed on the chart, then the SUV would be reduced further using the following equation (note that "| |" represents absolute value):

$$\frac{2}{3}x\,0.9^{(yds\ needed-BET\ from\ above)}x(SUV\ for\ 3rd\ down\ equivalent\ yardage)-[(1-\frac{2}{3}x\,0.9^{(yds\ needed-BET\ from\ above)}]x|SUV\ if\ defense\ takes\ over\ 1st\ and\ 10|.$$

The assumption here is that the SUV is reduced by 10% for each yard beyond the BET. Here are two examples. Say a team has 4th and 3 or less from its own 30, where the BET = 3. From the chart, this lies within the "go for it" region, so the SUV would be as follows:

$$\frac{2}{3}x\,0.39-\left(1-\frac{2}{3}\right)x\,3.40=-0.87$$

where 0.39 = SUV for 3rd and 3 (i.e., 5 or less) from 70 yards away and 3.40 is the SUV for 1st and 10 from 30 yards away. Now, if at the same field position it was 4th and 6, the SUV would be reduced using the following:

$$\frac{2}{3}x\,0.9^{(6-3)}x\,0.29-\left[1-\frac{2}{3}x\,0.9^{(6-3)}\right]x\,3.40=-1.61$$

but now using the SUV for 3rd and 6 from 70 yards away (0.29).

Based on the above, the SUVs for 4th down are presented in Tables 3 and 4 (anything above 20 yards to go was treated as constant, consistent with 1st, 2nd and 3rd downs).

A.1 Real Game Examples

The next step was to apply this to an actual game. The AFC playoff between Pittsburgh and Kansas City (January 15, 2017) was chosen, which Pittsburgh won 18-16 (see Reference 8). The analysis of the entire game is complete in Reference 1. Selected results are provided in Table 5.

Let's analyze Kansas City's scoring drive. Kansas City receives the punt at their own 20 (potential 1st and 10 from 80 yards away gives starting SUV = 0.28) and returns it 25 yards to the 45 (finishing SUV for 1st and 10 from 55 yards away = 1.79), an increase in SUV of 1.79 – 0.28 = 1.51. Next is a 7-yard gain to Pittsburgh's 48, making it 2nd and 7, which has an SUV = 2.22 for an increase of 2.22 – 1.79 = 0.43. Another run for 7 yards yields a 1st and 10 at Pittsburgh's 41, an SUV = 2.64 and another increase of 2.64 – 2.22 = 0.42. A 20-yard completion to the Pittsburgh 20 yields another 1st and 10, with an SUV = 4.20 for another gain of 4.20

– 2.64 = 1.56. Next is a 7-yard completion to the 13, where the SUV for 2nd and 3 is 4.84 – an increase of 4.84 – 4.20 = 0.64. Another completion to the 5 yields 1st and goal with an SUV = 5.50 (for 1st and 10 or less), an increase of 5.50 – 4.84 = 0.66. Finally a touchdown pass, with a successful extra point yields 7.00 points and a final SUV gain of 7.00 – 5.50 = 1.50. Summing all the SUV changes yields 6.72, which happens to be the difference between the final SUV (7.00) and the starting SUV (0.28), as expected.

Continuing with the game … (see Table 6). Also, let's analyze this drive, which resulted in a punt and included a penalty. The kickoff was taken in the end zone, which potentially is a 1st and 10 and the 25, giving a starting SUV from 75 yards away = 0.59. The kick was returned only 12 yards for a finishing SUV for 1st and 10 and 88 yards away = -0.20, a negative SUV change of -0.20 – 0.559 = -0.79. An incomplete pass makes it 2nd and 10, an SUV = -0.70 for a loss of 0.50 (negative SUV). Next is a 13-yard completion to the 25, where the SUV for 1st and 10 is 0.59, a gain of 1.29. Another completion for 4 yards yields 2nd a 6, with an SUV = 0.73 for another gain of 0.14. The next play is nullified by offensive holding, so it becomes 2nd and 16 from 71 yards away, with an SUV = -0.88, resulting in a decrease of 1.61. An incompletion makes it 3rd and 16, reducing the SUV to -0.88, another drop of 0.50. A completion of 9 yards still leaves 4th and 7 from 72 yards away, an SUV = -1.97, representing yet another decrease of 0.59. Kansas City punts to the Pittsburgh 29, where there is a fair catch and a starting SUV for the Steelers of 0.83, which is evaluated as a negative for Kansas City, i.e., -0.83. However, this play results in a gain of 1.14 from -1.97 to -0.83. Overall, this drive has a negative SUV of -1.42, again the difference between the finishing SUV of -0.38 and the starting SUV of 0.59.

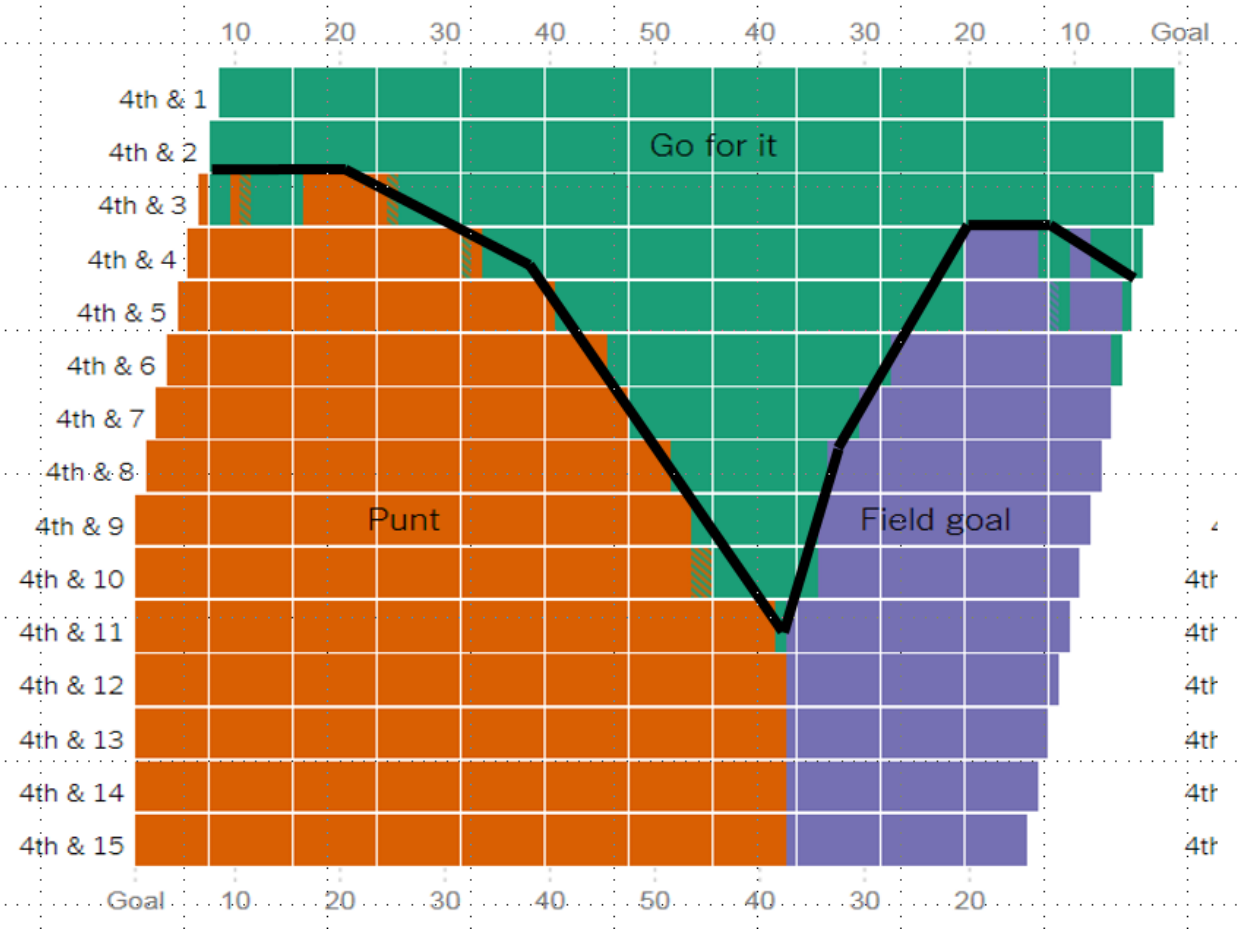

Figure 3. Chart Showing Efficacy of "Going for It" on Fourth Down (see Reference 6)

Table 3. SUVs for Field Positions – Fourth Down with Ten or Less "Yards to Go"

yd	pt (4/1)	pt (4/2)	pt (4/3)	pt (4/4)	pt (4/5)	pt (4/6)	pt (4/7)	pt (4/8)	pt (4/9)	pt (4/10)
1	3.53	3.53	3.53	3.53	3.04	2.54	2.10	1.71	1.36	1.04
2	3.47	3.47	3.47	3.47	3.02	2.56	2.16	1.80	1.48	1.20
3	3.30	3.30	3.30	3.30	2.88	2.45	2.06	1.72	1.42	1.15
4	3.13	3.13	3.13	3.13	2.74	2.33	1.97	1.65	1.37	1.11
5	3.10	3.10	3.10	3.10	2.72	2.32	1.97	1.66	1.39	1.14
6	3.07	3.07	3.07	3.07	2.70	2.32	1.98	1.67	1.41	1.17
7	3.03	3.03	3.03	3.03	2.68	2.31	1.98	1.69	1.43	1.20
8	2.99	2.99	2.99	2.99	2.64	2.28	1.96	1.68	1.43	1.20
9	2.94	2.94	2.94	2.61	2.31	1.99	1.71	1.46	1.24	1.05
10	2.89	2.89	2.89	2.57	2.28	1.97	1.70	1.46	1.25	1.06
11	2.86	2.86	2.86	2.55	2.27	1.97	1.70	1.47	1.26	1.07
12	2.83	2.83	2.83	2.52	2.25	1.96	1.70	1.47	1.27	1.09
13	2.79	2.79	2.79	2.50	2.24	1.95	1.70	1.48	1.28	1.10
14	2.76	2.76	2.76	2.48	2.22	1.94	1.70	1.48	1.29	1.12
15	2.73	2.73	2.73	2.45	2.21	1.94	1.70	1.49	1.30	1.14
16	2.67	2.67	2.67	2.39	2.15	1.88	1.65	1.44	1.25	1.09
17	2.59	2.59	2.59	2.32	2.08	1.81	1.58	1.37	1.19	1.03
18	2.52	2.52	2.52	2.25	2.01	1.74	1.51	1.30	1.12	0.96
19	2.45	2.45	2.45	2.18	1.94	1.67	1.44	1.23	1.05	0.89
20	2.37	2.37	2.37	2.11	1.87	1.60	1.37	1.17	0.99	0.83
21	2.30	2.30	2.30	2.03	1.80	1.53	1.30	1.10	0.92	0.76
22	2.22	2.22	2.22	1.96	1.73	1.46	1.23	1.03	0.85	0.69
23	2.15	2.15	2.15	2.15	1.89	1.60	1.35	1.12	0.92	0.75
24	2.08	2.08	2.08	2.08	1.82	1.53	1.28	1.05	0.85	0.68
25	2.00	2.00	2.00	2.00	1.75	1.46	1.21	0.98	0.79	0.61
26	1.93	1.93	1.93	1.93	1.93	1.61	1.33	1.09	0.87	0.68
27	1.86	1.86	1.86	1.86	1.86	1.54	1.26	1.02	0.80	0.61
28	1.78	1.78	1.78	1.78	1.78	1.72	1.41	1.14	0.90	0.69
29	1.71	1.71	1.71	1.71	1.71	1.64	1.34	1.07	0.83	0.62
30	1.64	1.64	1.64	1.64	1.64	1.57	1.26	1.00	0.76	0.55
31	1.56	1.56	1.56	1.56	1.56	1.50	1.43	1.13	0.87	0.64
32	1.49	1.49	1.49	1.49	1.49	1.42	1.36	1.06	0.80	0.57
33	1.42	1.42	1.42	1.42	1.42	1.35	1.28	1.22	0.93	0.67
34	1.34	1.34	1.34	1.34	1.34	1.28	1.21	1.14	0.86	0.60
35	1.27	1.27	1.27	1.27	1.27	1.20	1.14	1.07	1.00	0.72
36	1.21	1.21	1.21	1.21	1.21	1.14	1.08	1.01	0.94	0.66
37	1.15	1.15	1.15	1.15	1.15	1.08	1.02	0.95	0.88	0.82
38	1.09	1.09	1.09	1.09	1.09	1.02	0.96	0.89	0.82	0.76
39	1.03	1.03	1.03	1.03	1.03	0.96	0.90	0.83	0.76	0.70
40	0.97	0.97	0.97	0.97	0.97	0.90	0.84	0.77	0.70	0.64
41	0.91	0.91	0.91	0.91	0.91	0.84	0.77	0.71	0.64	0.57
42	0.85	0.85	0.85	0.85	0.85	0.78	0.71	0.65	0.58	0.30
43	0.79	0.79	0.79	0.79	0.79	0.72	0.65	0.59	0.52	0.24
44	0.73	0.73	0.73	0.73	0.73	0.66	0.59	0.53	0.46	0.18
45	0.67	0.67	0.67	0.67	0.67	0.60	0.53	0.47	0.40	0.12
46	0.61	0.61	0.61	0.61	0.61	0.54	0.47	0.41	0.12	-0.13
47	0.55	0.55	0.55	0.55	0.55	0.48	0.41	0.35	0.06	-0.19
48	0.49	0.49	0.49	0.49	0.49	0.42	0.35	0.29	0.00	-0.25
49	0.43	0.43	0.43	0.43	0.43	0.36	0.29	0.00	-0.26	-0.48
50	0.36	0.36	0.36	0.36	0.36	0.30	0.23	-0.06	-0.32	-0.54
51	0.30	0.30	0.30	0.30	0.30	0.24	0.17	-0.12	-0.38	-0.61
52	0.24	0.24	0.24	0.24	0.24	0.18	0.11	-0.18	-0.44	-0.67
53	0.18	0.18	0.18	0.18	0.18	0.12	-0.18	-0.45	-0.68	-0.88
54	0.12	0.12	0.12	0.12	0.12	0.06	-0.24	-0.51	-0.74	-0.94

yd	pt (4/1)	pt (4/2)	pt (4/3)	pt (4/4)	pt (4/5)	pt (4/6)	pt (4/7)	pt (4/8)	pt (4/9)	pt (4/10)
55	0.06	0.06	0.06	0.06	0.06	0.00	-0.30	-0.57	-0.80	-1.00
56	0.00	0.00	0.00	0.00	0.00	-0.30	-0.57	-0.81	-1.02	-1.20
57	-0.06	-0.06	-0.06	-0.06	-0.06	-0.36	-0.63	-0.87	-1.08	-1.26
58	-0.12	-0.12	-0.12	-0.12	-0.12	-0.42	-0.69	-0.93	-1.14	-1.32
59	-0.18	-0.18	-0.18	-0.18	-0.18	-0.48	-0.75	-0.99	-1.20	-1.38
60	-0.24	-0.24	-0.24	-0.24	-0.48	-0.76	-1.00	-1.22	-1.40	-1.57
61	-0.30	-0.30	-0.30	-0.30	-0.54	-0.82	-1.06	-1.28	-1.46	-1.63
62	-0.36	-0.36	-0.36	-0.36	-0.61	-0.88	-1.12	-1.34	-1.52	-1.69
63	-0.42	-0.42	-0.42	-0.42	-0.67	-0.94	-1.18	-1.40	-1.58	-1.75
64	-0.48	-0.48	-0.48	-0.48	-0.73	-1.00	-1.24	-1.46	-1.64	-1.81
65	-0.54	-0.54	-0.54	-0.79	-1.01	-1.26	-1.47	-1.67	-1.83	-1.98
66	-0.61	-0.61	-0.61	-0.85	-1.08	-1.33	-1.55	-1.74	-1.91	-2.06
67	-0.67	-0.67	-0.67	-0.92	-1.15	-1.40	-1.62	-1.81	-1.98	-2.13
68	-0.74	-0.74	-0.74	-0.99	-1.22	-1.47	-1.69	-1.88	-2.05	-2.20
69	-0.81	-0.81	-0.81	-1.06	-1.29	-1.54	-1.76	-1.95	-2.13	-2.28
70	-0.87	-0.87	-0.87	-1.13	-1.35	-1.61	-1.83	-2.03	-2.20	-2.35
71	-0.94	-0.94	-0.94	-1.20	-1.42	-1.68	-1.90	-2.10	-2.27	-2.43
72	-1.01	-1.01	-1.01	-1.26	-1.49	-1.75	-1.97	-2.17	-2.35	-2.50
73	-1.08	-1.08	-1.33	-1.56	-1.77	-2.00	-2.20	-2.38	-2.54	-2.68
74	-1.14	-1.14	-1.40	-1.63	-1.84	-2.07	-2.28	-2.46	-2.61	-2.75
75	-1.21	-1.21	-1.47	-1.70	-1.91	-2.14	-2.35	-2.53	-2.69	-2.83
76	-1.28	-1.28	-1.54	-1.77	-1.98	-2.22	-2.42	-2.60	-2.76	-2.90
77	-1.34	-1.34	-1.60	-1.84	-2.05	-2.29	-2.49	-2.68	-2.84	-2.98
78	-1.41	-1.41	-1.67	-1.91	-2.12	-2.36	-2.57	-2.75	-2.91	-3.05
79	-1.48	-1.48	-1.74	-1.98	-2.19	-2.43	-2.64	-2.82	-2.98	-3.13
80	-1.54	-1.54	-1.81	-2.05	-2.26	-2.50	-2.71	-2.89	-3.06	-3.20
81	-1.61	-1.61	-1.88	-2.12	-2.33	-2.57	-2.78	-2.97	-3.13	-3.27
82	-1.68	-1.68	-1.95	-2.19	-2.40	-2.64	-2.85	-3.04	-3.20	-3.35
83	-1.74	-1.74	-2.01	-2.26	-2.47	-2.72	-2.93	-3.11	-3.28	-3.42
84	-1.81	-1.81	-2.08	-2.33	-2.55	-2.79	-3.00	-3.19	-3.35	-3.50
85	-1.88	-1.88	-2.15	-2.40	-2.62	-2.86	-3.07	-3.26	-3.43	-3.57
86	-1.95	-1.95	-2.22	-2.46	-2.69	-2.93	-3.14	-3.33	-3.50	-3.65
87	-2.01	-2.01	-2.29	-2.53	-2.76	-3.00	-3.22	-3.41	-3.57	-3.72
88	-2.08	-2.08	-2.35	-2.60	-2.83	-3.07	-3.29	-3.48	-3.65	-3.79
89	-2.15	-2.15	-2.42	-2.67	-2.90	-3.14	-3.36	-3.55	-3.72	-3.87
90	-2.21	-2.21	-2.49	-2.74	-2.97	-3.21	-3.43	-3.62	-3.79	-3.94
91	-2.29	-2.29	-2.57	-2.82	-3.05	-3.30	-3.52	-3.71	-3.88	-4.03
92	-2.36	-2.36	-2.64	-2.90	-3.13	-3.38	-3.60	-3.80	-3.97	-4.12
93	-2.43	-2.43	-2.72	-2.98	-3.21	-3.46	-3.69	-3.88	-4.06	-4.21
94	-2.53	-2.53	-2.82	-3.08	-3.31	-3.56	-3.79	-3.98	-4.16	-4.31
95	-2.63	-2.63	-2.92	-3.18	-3.41	-3.66	-3.89	-4.08	-4.26	-4.41
96	-2.73	-2.73	-3.02	-3.28	-3.51	-3.76	-3.99	-4.18	-4.36	-4.51
97	-2.90	-2.90	-3.20	-3.47	-3.71	-3.98	-4.21	-4.41	-4.59	-4.75
98	-3.07	-3.07	-3.38	-3.66	-3.92	-4.19	-4.43	-4.64	-4.83	-4.99
99	-3.43	-3.43	-3.74	-4.02	-4.26	-4.53	-4.77	-4.98	-5.16	-5.32

Table 4. SUVs for Field Positions – Fourth Down with More than Ten "Yards to Go"

yd	pt (4/11)	pt (4/12)	pt (4/13)	pt (4/14)	pt (4/15)	pt (4/16)	pt (4/17)	pt (4/18)	pt (4/19)	pt (4/20+)
1	0.77	0.52	0.30	0.11	-0.06	-0.21	-0.35	-0.47	-0.58	-0.67
2	0.95	0.72	0.52	0.35	0.19	0.05	-0.07	-0.18	-0.27	-0.36
3	0.92	0.71	0.52	0.36	0.21	0.08	-0.04	-0.14	-0.23	-0.31

yd	pt (4/11)	pt (4/12)	pt (4/13)	pt (4/14)	pt (4/15)	pt (4/16)	pt (4/17)	pt (4/18)	pt (4/19)	pt (4/20+)
4	0.89	0.69	0.52	0.36	0.23	0.10	0.00	-0.10	-0.18	-0.26
5	0.93	0.73	0.57	0.42	0.28	0.17	0.06	-0.03	-0.11	-0.18
6	0.96	0.78	0.61	0.47	0.34	0.23	0.13	0.04	-0.04	-0.11
7	1.00	0.82	0.66	0.52	0.40	0.29	0.19	0.11	0.04	-0.03
8	1.01	0.83	0.68	0.55	0.43	0.32	0.23	0.15	0.07	0.01
9	0.88	0.73	0.59	0.47	0.37	0.28	0.20	0.13	0.06	0.01
10	0.89	0.74	0.62	0.50	0.40	0.31	0.23	0.16	0.10	0.05
11	0.91	0.77	0.64	0.53	0.43	0.35	0.27	0.21	0.15	0.09
12	0.93	0.79	0.67	0.56	0.47	0.38	0.31	0.25	0.19	0.14
13	0.95	0.82	0.70	0.59	0.50	0.42	0.35	0.29	0.23	0.18
14	0.97	0.84	0.73	0.62	0.54	0.46	0.39	0.33	0.28	0.23
15	0.99	0.87	0.75	0.66	0.57	0.49	0.43	0.37	0.32	0.27
16	0.95	0.83	0.72	0.62	0.53	0.46	0.39	0.34	0.29	0.24
17	0.88	0.76	0.65	0.55	0.47	0.40	0.33	0.27	0.22	0.18
18	0.82	0.69	0.59	0.49	0.41	0.33	0.27	0.21	0.16	0.12
19	0.75	0.63	0.52	0.43	0.34	0.27	0.20	0.15	0.10	0.05
20	0.69	0.56	0.46	0.36	0.28	0.20	0.14	0.08	0.03	-0.01
21	0.62	0.50	0.39	0.30	0.21	0.14	0.08	0.02	-0.03	-0.07
22	0.55	0.43	0.33	0.23	0.15	0.08	0.01	-0.04	-0.09	-0.13
23	0.59	0.46	0.34	0.24	0.15	0.07	0.00	-0.07	-0.12	-0.17
24	0.53	0.39	0.28	0.17	0.08	0.00	-0.07	-0.13	-0.18	-0.23
25	0.46	0.33	0.21	0.11	0.02	-0.06	-0.13	-0.19	-0.24	-0.29
26	0.51	0.36	0.23	0.12	0.02	-0.07	-0.14	-0.21	-0.27	-0.32
27	0.44	0.30	0.17	0.05	-0.05	-0.13	-0.21	-0.28	-0.33	-0.38
28	0.50	0.34	0.20	0.07	-0.04	-0.13	-0.22	-0.29	-0.36	-0.41
29	0.44	0.27	0.13	0.01	-0.10	-0.20	-0.28	-0.36	-0.42	-0.48
30	0.37	0.21	0.06	-0.06	-0.17	-0.26	-0.35	-0.42	-0.48	-0.54
31	0.44	0.26	0.10	-0.03	-0.15	-0.26	-0.35	-0.43	-0.50	-0.56
32	0.37	0.19	0.04	-0.10	-0.22	-0.32	-0.42	-0.50	-0.57	-0.63
33	0.45	0.26	0.08	-0.07	-0.20	-0.31	-0.42	-0.50	-0.58	-0.65
34	0.38	0.19	0.02	-0.13	-0.27	-0.38	-0.48	-0.57	-0.65	-0.71
35	0.48	0.26	0.07	-0.09	-0.24	-0.36	-0.48	-0.57	-0.66	-0.73
36	0.42	0.20	0.01	-0.15	-0.30	-0.42	-0.54	-0.63	-0.72	-0.79
37	0.54	0.30	0.09	-0.09	-0.25	-0.39	-0.52	-0.62	-0.72	-0.80
38	0.69	0.42	0.19	-0.01	-0.19	-0.35	-0.49	-0.61	-0.71	-0.81
39	0.42	0.18	-0.03	-0.21	-0.37	-0.51	-0.64	-0.75	-0.84	-0.92
40	0.36	0.12	-0.09	-0.27	-0.43	-0.57	-0.70	-0.81	-0.90	-0.98
41	0.30	0.06	-0.15	-0.33	-0.49	-0.63	-0.76	-0.87	-0.96	-1.04
42	0.06	-0.16	-0.35	-0.51	-0.66	-0.79	-0.90	-0.99	-1.08	-1.15
43	0.00	-0.22	-0.41	-0.57	-0.72	-0.85	-0.96	-1.06	-1.14	-1.21
44	-0.06	-0.28	-0.47	-0.63	-0.78	-0.91	-1.02	-1.12	-1.20	-1.27
45	-0.12	-0.34	-0.53	-0.69	-0.84	-0.97	-1.08	-1.18	-1.26	-1.34
46	-0.35	-0.55	-0.72	-0.87	-1.00	-1.11	-1.21	-1.30	-1.37	-1.44
47	-0.41	-0.61	-0.78	-0.93	-1.06	-1.17	-1.27	-1.36	-1.43	-1.50
48	-0.47	-0.67	-0.84	-0.99	-1.12	-1.23	-1.33	-1.42	-1.50	-1.56
49	-0.68	-0.86	-1.01	-1.14	-1.26	-1.37	-1.46	-1.53	-1.60	-1.66
50	-0.74	-0.92	-1.07	-1.21	-1.32	-1.43	-1.52	-1.59	-1.66	-1.72
51	-0.80	-0.98	-1.13	-1.27	-1.38	-1.49	-1.58	-1.66	-1.72	-1.78
52	-0.86	-1.04	-1.19	-1.33	-1.44	-1.55	-1.64	-1.72	-1.78	-1.84
53	-1.06	-1.22	-1.35	-1.48	-1.58	-1.67	-1.76	-1.83	-1.89	-1.94
54	-1.12	-1.28	-1.41	-1.54	-1.64	-1.73	-1.82	-1.89	-1.95	-2.00
55	-1.18	-1.34	-1.48	-1.60	-1.70	-1.79	-1.88	-1.95	-2.01	-2.06
56	-1.36	-1.50	-1.63	-1.74	-1.83	-1.92	-1.99	-2.05	-2.11	-2.16
57	-1.42	-1.56	-1.69	-1.80	-1.89	-1.98	-2.05	-2.11	-2.17	-2.22
58	-1.48	-1.62	-1.75	-1.86	-1.95	-2.04	-2.11	-2.17	-2.23	-2.28
59	-1.54	-1.68	-1.81	-1.92	-2.01	-2.10	-2.17	-2.23	-2.29	-2.34
60	-1.71	-1.84	-1.95	-2.05	-2.14	-2.21	-2.28	-2.33	-2.38	-2.43
61	-1.77	-1.90	-2.01	-2.11	-2.20	-2.27	-2.34	-2.39	-2.44	-2.49

yd	pt (4/11)	pt (4/12)	pt (4/13)	pt (4/14)	pt (4/15)	pt (4/16)	pt (4/17)	pt (4/18)	pt (4/19)	pt (4/20+)
62	-1.83	-1.96	-2.07	-2.17	-2.26	-2.33	-2.40	-2.45	-2.50	-2.55
63	-1.89	-2.02	-2.13	-2.23	-2.32	-2.39	-2.46	-2.51	-2.57	-2.61
64	-1.95	-2.08	-2.19	-2.29	-2.38	-2.45	-2.52	-2.58	-2.63	-2.67
65	-2.11	-2.23	-2.33	-2.42	-2.49	-2.56	-2.62	-2.67	-2.72	-2.76
66	-2.19	-2.30	-2.40	-2.49	-2.57	-2.64	-2.70	-2.75	-2.79	-2.83
67	-2.26	-2.38	-2.48	-2.57	-2.65	-2.71	-2.77	-2.83	-2.87	-2.91
68	-2.34	-2.45	-2.55	-2.64	-2.72	-2.79	-2.85	-2.90	-2.95	-2.99
69	-2.41	-2.53	-2.63	-2.72	-2.80	-2.87	-2.93	-2.98	-3.03	-3.07
70	-2.49	-2.60	-2.71	-2.80	-2.88	-2.94	-3.01	-3.06	-3.11	-3.15
71	-2.56	-2.68	-2.78	-2.87	-2.95	-3.02	-3.08	-3.14	-3.18	-3.22
72	-2.63	-2.75	-2.86	-2.95	-3.03	-3.10	-3.16	-3.21	-3.26	-3.30
73	-2.80	-2.91	-3.00	-3.09	-3.16	-3.22	-3.28	-3.33	-3.37	-3.41
74	-2.88	-2.98	-3.08	-3.16	-3.23	-3.30	-3.35	-3.40	-3.45	-3.48
75	-2.95	-3.06	-3.15	-3.24	-3.31	-3.38	-3.43	-3.48	-3.52	-3.56
76	-3.03	-3.13	-3.23	-3.31	-3.39	-3.45	-3.51	-3.56	-3.60	-3.64
77	-3.10	-3.21	-3.31	-3.39	-3.46	-3.53	-3.59	-3.64	-3.68	-3.72
78	-3.18	-3.29	-3.38	-3.47	-3.54	-3.61	-3.66	-3.71	-3.76	-3.80
79	-3.25	-3.36	-3.46	-3.54	-3.62	-3.68	-3.74	-3.79	-3.83	-3.87
80	-3.33	-3.44	-3.53	-3.62	-3.69	-3.76	-3.82	-3.87	-3.91	-3.95
81	-3.40	-3.51	-3.61	-3.70	-3.77	-3.84	-3.90	-3.95	-3.99	-4.03
82	-3.48	-3.59	-3.69	-3.77	-3.85	-3.91	-3.97	-4.02	-4.07	-4.11
83	-3.55	-3.66	-3.76	-3.85	-3.92	-3.99	-4.05	-4.10	-4.15	-4.19
84	-3.63	-3.74	-3.84	-3.92	-4.00	-4.07	-4.13	-4.18	-4.22	-4.26
85	-3.70	-3.81	-3.91	-4.00	-4.08	-4.15	-4.20	-4.26	-4.30	-4.34
86	-3.78	-3.89	-3.99	-4.08	-4.15	-4.22	-4.28	-4.33	-4.38	-4.42
87	-3.85	-3.96	-4.06	-4.15	-4.23	-4.30	-4.36	-4.41	-4.46	-4.50
88	-3.93	-4.04	-4.14	-4.23	-4.31	-4.38	-4.44	-4.49	-4.54	-4.58
89	-4.00	-4.12	-4.22	-4.31	-4.38	-4.45	-4.51	-4.57	-4.61	-4.65
90	-4.08	-4.19	-4.29	-4.38	-4.46	-4.53	-4.59	-4.64	-4.69	-4.73
91	-4.16	-4.28	-4.38	-4.47	-4.55	-4.62	-4.69	-4.74	-4.79	-4.83
92	-4.25	-4.37	-4.48	-4.57	-4.65	-4.72	-4.78	-4.83	-4.88	-4.92
93	-4.34	-4.46	-4.57	-4.66	-4.74	-4.81	-4.87	-4.93	-4.98	-5.02
94	-4.44	-4.56	-4.67	-4.76	-4.84	-4.91	-4.97	-5.03	-5.08	-5.12
95	-4.54	-4.66	-4.77	-4.86	-4.94	-5.01	-5.07	-5.13	-5.18	-5.22
96	-4.64	-4.76	-4.87	-4.96	-5.04	-5.11	-5.17	-5.23	-5.28	-5.32
97	-4.89	-5.02	-5.13	-5.22	-5.31	-5.38	-5.45	-5.50	-5.56	-5.60
98	-5.14	-5.27	-5.38	-5.48	-5.57	-5.65	-5.72	-5.78	-5.83	-5.88
99	-5.47	-5.59	-5.71	-5.80	-5.89	-5.97	-6.03	-6.09	-6.14	-6.19

This analysis continues through the entire game, with the final SUV results shown in Table 7. This summarize all the drives and give the total SUVs for the game, broken down by type of play and for three individual players (one quarterback, one running back and one wide receiver) for each team. The green entries for Pittsburgh remove the SUVs from the kneel-downs. Incomplete passes are attributed fully to the quarterback, except if there is a clear indication that the receiver dropped the ball, in which case he receives full negative credit. Pass completions are halved between the quarterback and receiver. Individual players also get (or lose) credit for kick returns and penalties. Quarterback runs are attributed solely to the quarterback (so a sack is treated as a run, not a pass). Quarterbacks get full negative credit for interceptions, unless there is clear indication that the receiver bobbled the ball causing the interception. Other "judgmental" assignments can be made as needed based on particulars of a play. The results suggest that, while the game was very close (an 18-16 Pittsburgh victory via a missed two-point conversion by Kansas City at the end), Pittsburgh dominated the play (SUV = 14.60 vs. 5.41), given they drove for six field goals and nearly a touchdown (end zone interception).

Following this exercise, it was clear that some expediting could be done, in particular assigning the SUV for each play to the particular type of play (kick, run, pass, etc.), as this would streamline the summation effort at the end. This was done for the next game, the Giants' 20-19 Super Bowl XXV win over Buffalo, when Norwood missed the field goal "wide right" at the end. This game also had a safety, which is discussed in the next paragraph with reference to Table 8, which shows selected results as with Example 1. Again, Reference 1 provides the complete game analysis.

With respect to Drive Nyg-04, the safety and post-safety excessive celebration penalty were treated separately. For the safety, the Giants started 2nd and 10 from their own 7, an SUV = -1.00 at 93 yards away. The safety resulted in a loss of 2.00 points and a free kick, which was treated as giving the ball to Buffalo at their 25 (SUV = 0.59), where they would have been without the 10-yard penalty. Thus, the finishing SUV was the negative sum of the safety (-2.00) and Buffalo's assumed starting position (-0.59), or -2.59,

resulting in an SUV decrease for the play of -1.59. The penalty was treated as Buffalo getting the ball at their 25 and losing 10 yards, a change in SUV from 0.59 to -0.02 for them, or from -0.59 to +0.02 for the Giants, an increase of 0.61.

As with Example 1, this analysis continues through the entire game, with the final SUV results shown in Table 9. Again, the green highlighted entries remove the SUVs for kneel-downs. The SUVs for both teams are essentially equal, consistent with the closeness of the game and the fact that both teams scored two touchdowns and drove far enough for two field goal attempts each, with Buffalo missing its last one (partially compensated with the safety).

Another streamlining effort for a future time would be to assign EXCEL Name Labels to each specific triplet of field position, down and yards to go, such that, rather than looking this up from the tables manually, they could automatically be entered into a spreadsheet. For example, if "1st down, 10 yards to go, from 55 yards away" (SUV = 1.79) were labeled as "55_1_10-," entering this directly would automatically provide the SUV (note the "10-" where the minus sign means the SUV is the same for all 1st and 10 yards or less).

Table 5. Selected Results from Example 1 (Pittsburgh-18, Kansas City-16, January 15, 2017)

DRIVE pit-01	**SUV: start**	**finish**	**delta**
(15:00 - 1st) C.Santos kicks 63 yards from KC 35 to PIT 2. J.Gilbert to PIT 30 for 28 yards (A.Sherman).	-1.00	0.89	1.89
1st and 10 at PIT 30			
(14:54 - 1st) (Shotgun) B.Roethlisberger pass incomplete short middle to L.Bell (D.Poe).	0.89	0.39	-0.50
2nd and 10 at PIT 30			
(14:50 - 1st) (Shotgun) B.Roethlisberger pass short right to A.Brown to PIT 37 for 7 yards (R.Parker).	0.39	0.81	0.42
3rd and 3 at PIT 37			
(14:14 - 1st) (No Huddle, Shotgun) B.Roethlisberger pass short left to E.Rogers to PIT 41 for 4 yards (E.Berry).	0.81	1.55	0.74
1st and 10 at PIT 41			
(13:38 - 1st) (No Huddle, Shotgun) B.Roethlisberger pass short right to J.James to KC 46 for 13 yards (R.Parker; D.Sorensen).	1.55	2.34	0.79
1st and 10 at KC 46			
(12:58 - 1st) (No Huddle, Shotgun) B.Roethlisberger pass short middle to J.James to KC 30 for 16 yards (M.Peters; E.Berry).	2.34	3.40	1.06
1st and 10 at KC 30			
(12:16 - 1st) (No Huddle, Shotgun) L.Bell right guard to KC 24 for 6 yards (J.Jenkins).	3.40	3.88	0.48
2nd and 4 at KC 24			
(11:38 - 1st) L.Bell right guard to KC 13 for 11 yards (J.Houston).	3.88	4.76	0.88
1st and 10 at KC 13			
(11:01 - 1st) (Shotgun) L.Bell up the middle to KC 5 for 8 yards (R.Wilson).	4.76	5.50	0.74
2nd and 2 at KC 5			
(10:18 - 1st) (No Huddle, Shotgun) B.Roethlisberger pass incomplete short right to L.Bell.	5.50	5.00	-0.50
3rd and 2 at KC 5			
(10:11 - 1st) (No Huddle, Shotgun) B.Roethlisberger pass short left to E.Rogers to KC 4 for 1 yard (R.Parker).	5.00	3.13	-1.87
4th and 1 at KC 4			
(9:38 - 1st) Chris Boswell 22 Yd Field Goal	3.13	3.00	-0.13
	RESULT		
	-1.00	3.00	**4.00**

DRIVE KCI-01	**SUV: start**	**finish**	**delta**
(9:38 - 1st) C.Boswell kicks 45 yards from PIT 35 to KC 20. D.Harris to KC 45 for 25 yards (D.Heyward-Bey).	0.28	1.79	1.51
1st and 10 at KC 45			
(9:31 - 1st) (Shotgun) S.Ware right guard to PIT 48 for 7 yards (J.Harrison).	1.79	2.22	0.43
2nd and 3 at PIT 48			
(9:01 - 1st) (No Huddle) T.Hill right end to PIT 41 for 7 yards (R.Shazier).	2.22	2.64	0.42
1st and 10 at PIT 41			

DRIVE pit-01	SUV: start	finish	delta
(8:11 - 1st) (Shotgun) A.Smith pass short right to T.Kelce to PIT 20 for 21 yards (S.Davis).	2.64	4.20	1.56
1st and 10 at PIT 20			
(7:24 - 1st) (Shotgun) A.Smith pass short middle to T.Hill to PIT 13 for 7 yards (B.Dupree).	4.20	4.84	0.64
2nd and 3 at PIT 13			
(6:48 - 1st) A.Smith pass short left to J.Maclin to PIT 5 for 8 yards (A.Burns).	4.84	5.50	0.66
1st and Goal at PIT 5			
(6:09 - 1st) Albert Wilson Pass From Alex Smith for 5 Yrds C.Santos extra point is Good	5.50	7.00	1.50
	RESULT		
	0.28	7.00	**6.72**

Table 6. Selected Results from Example 1 Continued

DRIVE pit-02	SUV: start	finish	delta
(6:09 - 1st) C.Santos kicks 65 yards from KC 35 to end zone, Touchback.	0.59	0.59	0.00
1st and 10 at PIT 25			
(6:09 - 1st) L.Bell left guard to PIT 25 for no gain (R.Wilson).	0.59	0.09	-0.50
2nd and 10 at PIT 25			
(5:33 - 1st) (Shotgun) B.Roethlisberger pass incomplete short right to A.Brown.	0.09	-0.41	-0.50
3rd and 10 at PIT 25			
(5:28 - 1st) (Shotgun) B.Roethlisberger pass deep left to A.Brown to KC 23 for 52 yards (J.Houston).	-0.41	3.96	4.37
1st and 10 at KC 23			
(4:44 - 1st) (No Huddle, Shotgun) B.Roethlisberger pass incomplete short right to J.James.	3.96	3.46	-0.50
2nd and 10 at KC 23			
(4:41 - 1st) (Shotgun) B.Roethlisberger pass short right to E.Rogers pushed ob at KC 20 for 3 yards (S.Nelson).	3.46	3.50	0.04
3rd and 7 at KC 20			
(4:02 - 1st) (Shotgun) B.Roethlisberger pass incomplete short left to A.Brown.	3.50	1.37	-2.13
4th and 7 at KC 20			
(3:51 - 1st) Chris Boswell 38 Yd Field Goal	1.37	3.00	1.63
	RESULT		
	0.59	3.00	**2.41**

Table 7. SUV Summaries from Example 1 (Pittsburgh-18, Kansas City-16, January 15, 2017)

PITTSBURGH

DRIVE	Ben	Bell	Brown	kick	run	pass	pen.	kneel	punt	FG	SUM	CUMU
01	-0.430	2.100	0.210	1.89	2.10	0.14	0.00	0.00	0.00	-0.13	4.00	4.00
02	-0.925	-0.500	2.185	0.00	-0.50	1.28	0.00	0.00	0.00	1.63	2.41	6.41
03	-2.360	1.910	0.330	0.00	2.05	-2.06	0.00	0.00	0.00	2.18	2.17	8.58
04	-4.690	0.860	0.000	0.00	0.86	-3.60	0.00	0.00	0.00	0.00	-2.74	5.84
05	-3.345	1.830	0.385	0.00	2.35	-3.13	-0.71	0.00	0.00	2.70	1.21	7.05
half	1.110	0.000	1.110	0.00	0.00	2.22	0.00	0.00	0.00	0.00	2.22	9.27
06	-1.685	1.645	0.180	0.00	2.83	-2.87	0.00	0.00	0.00	2.39	2.35	11.62
07	0.000	-1.150	0.000	0.00	-1.15	0.00	0.00	0.00	-0.19	0.00	-1.34	10.28
08	-1.885	-0.780	0.000	1.49	-4.15	3.37	0.00	0.00	0.00	2.89	3.60	13.88
end	-3.550	-0.100	0.460	-0.20	-0.10	1.02	0.00	-4.06	0.00	0.00	-3.34	10.54
T	-17.760	5.815	4.860	3.18	4.29	-3.63	-0.71	-4.06	-0.19	11.66	10.54	10.54
end	0.510	-0.100	0.460	-0.20	-0.10	1.02	0.00	0.00	0.00	0.00	0.72	14.60
T	-13.700	5.815	4.860	3.18	4.29	-3.63	-0.71	0.00	-0.19	11.66	14.60	14.60

Brown SUVs include two punt returns in KCI-04 (in pit-05, 6 yards from Pit 39 for +0.36) and KCI-06 (in pit-06, 3 yards from Pit 23 for +0.18).

KANSAS CITY

DRIVE	Smith	Hill	Kelce	kick	run	pass	pen.	kneel	punt	FG	SUM	CUMU
01	2.180	0.740	0.780	1.51	0.85	4.36	0.00	0.00	0.00	0.00	6.72	6.72
02	-1.645	-1.085	0.645	-0.79	0.00	-0.16	-1.61	0.00	1.14	0.00	-1.42	5.30
03	-3.340	0.310	0.000	0.00	-0.02	-3.03	0.00	0.00	0.00	0.00	-3.05	2.25
04	-2.760	0.000	0.000	0.00	-0.01	-2.76	0.00	0.00	0.70	0.00	-2.07	0.18
05	-0.190	0.070	0.000	-0.55	0.00	-2.95	0.21	0.00	0.00	0.00	-3.29	-3.11
06	-2.970	1.230	0.000	1.23	-0.66	-2.97	0.00	0.00	2.45	0.00	0.05	-3.06
07	-4.380	2.220	0.000	1.74	-1.44	-1.48	1.51	0.00	2.07	0.00	2.40	-0.66
08	-0.210	0.000	-1.380	0.00	-0.66	1.34	-1.38	0.00	0.00	1.36	0.66	0.00
09	0.330	0.040	0.980	0.00	0.21	4.26	0.94	0.00	0.00	0.00	5.41	5.41
T	-12.985	3.525	1.025	3.14	-1.73	-3.39	-0.33	0.00	6.36	1.36	5.41	5.41

Smith SUVs includes completed pass fumbled by receiver in KCI-05 (8 yards from KCI 30 for +0.48/2 = +0.24).

Table 8. Selected Results from Example 2 (NY Giants-20, Buffalo-19, Super Bowl XXV)

DRIVE Buf-03											
Yard	**Down**	**Play**	**Start**	**Kick**	**Run**	**Pass**	**Pen.**	**Knee**	**Punt**	**FG**	**Delta**
B 20	1–10	Thomas 3 run middle (Howard).	0.28		0.27						-0.01
B 23	2–7	Kelly 11 pass to Reed right (Thompson, Collins).	0.27			1.13					0.86
B 34	1–10	Kelly 4 pass to Reed left (Thompson, Banks).	1.13			1.27					0.14
B 38	2–6	Buffalo penalized 5 for false start (Ritcher).	1.27				0.47				-0.80
B 33	2–11	Kelly 20 pass to Reed middle (Collins, Walls).	0.47			2.28					1.81
N 47	1–10	Thomas 6 Shotgun draw left (Reasons).	2.28		2.64						0.36
N 41	2–4	Kelly 13 pass to Thomas short right (Banks).	2.64		3.56						0.92
N 28	1–10	K. Davis 3 run right (Howard).	3.56		3.60						0.04
N 25	2–7	Kelly 9 pass to Reed crossing right (Collins).	3.60			4.52					0.92
N 16	1–10	Thomas 3 run right (Johnson).	4.52		4.56						0.04
N 13	2–7	Kelly 5 pass to McKeller left (Guyton).	4.56			4.70					0.14
N 8	3–2	New York penalized 4 (half the distance) for	4.70				5.60				0.90

		roughing the passer (Marshall). New York– first time out (13:14).									
N 4	1–go	Mueller 3 run middle (Taylor).	5.60		6.50						0.90
N 1	2–go	D. Smith 1 run right, touchdown (12:30). Norwood kicked extra point.	6.50		7.00						0.50
Total			41.38	0.00	2.75	3.87	0.10	0.00	0.00	0.00	**6.72**

DRIVE Nyg-03											
Yard	**Down**	**Play**	**Start**	**Kick**	**Run**	**Pass**	**Pen.**	**Knee**	**Punt**	**FG**	**Delta**
Norwood kick to NY 10, Duerson 22 return (Tasker).			-0.32	1.01							1.33
N 32	1–10	Hostetler 2 scramble left (out of bounds).	1.01		0.83						-0.18
N 34	2–8	Anderson 2 run middle (Wright).	0.83		0.65						-0.18
N 36	3–6	Hostetler hit as he threw (Seals), pass to Kyles incomplete.	0.65			-1.00					-1.65
N 36	4–6	Landeta 37 punt, Edwards fair catch.	-1.00						-0.71		0.29
Total			1.17	1.33	-0.36	-1.65	0.00	0.00	0.29	0.00	**-0.39**

DRIVE Buf-04											
Yard	**Down**	**Play**	**Start**	**Kick**	**Run**	**Pass**	**Pen.**	**Knee**	**Punt**	**FG**	**Delta**
B 27	1–10	Thomas 14 run left (Walls, P. Williams).	0.71		1.55						0.84
B 41	1–10	Thomas 4 run left (Johnson).	1.55		1.69						0.14
B 45	2–6	Kelly pass to Reed right broken up (Guyton), incomplete.	1.69			1.19					-0.50
B 45	3–6	New York penalized 5 for offsides (Howard).	1.19				1.59				0.40
50	3–1	Kelly pass to Reed middle dropped, incomplete.	1.59			0.36					-1.23
50	4–1	Tuten 43 punt, Meggett fair catch.	0.36						0.50		0.14
Total			7.09	0.00	-0.71	-0.04	0.40	0.00	0.14	0.00	**-0.21**

DRIVE Nyg-04											
Yard	**Down**	**Play**	**Start**	**Kick**	**Run**	**Pass**	**Pen.**	**Knee**	**Punt**	**FG**	**Delta**
N 7	1–10	Hostetler 7 pass to Anderson middle (K. Jackson).	-0.50			-0.08					0.42
N 14	2–3	Anderson 3 run middle (Bentley). Play nullified and New York penalized 7 (half the distance) for holding (Oates).	-0.08				-1.00				-0.92
N 7	2–10	Hostetler tripped over Anderson, regained footing, then sacked, loss of 7 (B. Smith), **SAFETY** (8:27). Buffalo penalized 5 for excessive celebration (B. Smith), assessed on free kick. Landeta free kick from NY 25 to B 15. **Treated as if kick went to B 25 (if no penalty).**	-1.00		-2.59						-1.59
Buffalo penalized 5 for excessive celebration (B. Smith), assessed on free kick. Landeta free kick from NY 25 to B 15. **Treated as if kick went to B 25, with 10-yd penalty taking it back to 15.**			-0.59				0.02				0.61
Total			-2.17	0.00	-1.59	0.42	-0.31	0.00	0.00	0.00	**-1.48**

Table 9. SUV Summaries from Example 2 (NY Giants-20, Buffalo-19, Super Bowl XXV)

Nyg Summary												
DRIVE	**Hoss**	**Meggett**	**Bavaro**	**kick**	**run**	**pass**	**pen.**	**kneel**	**punt**	**FG**	**SUM**	**CUMU**
01	2.535	2.110	0.000	0.00	-3.52	4.24	0.30	0.00	0.00	1.03	2.05	2.05
02	0.470	-1.100	0.000	0.00	0.74	-0.36	0.00	0.00	-0.94	0.00	-0.56	1.49
03	-1.830	0.000	0.000	1.33	-0.36	-1.65	0.00	0.00	0.29	0.00	-0.39	1.10
04	-2.380	0.000	0.000	0.00	-1.59	0.42	-0.31	0.00	0.00	0.00	-1.48	-0.38
05	-1.260	0.000	0.000	0.00	-0.08	-1.26	0.00	0.00	0.83	0.00	-0.51	-0.89
06	2.155	1.240	0.180	0.00	1.83	5.31	0.00	0.00	0.00	0.00	7.14	6.25
07	2.795	1.735	-1.800	0.97	3.45	5.97	-3.01	0.00	0.00	0.00	7.38	13.63
08	0.160	0.000	0.000	0.00	-5.57	0.78	0.30	0.00	0.00	0.00	-4.49	9.14
09	-0.720	1.910	1.360	0.61	1.67	1.16	0.00	0.00	0.00	-0.30	3.14	12.28
10	-0.955	-0.500	0.215	0.00	0.95	0.43	0.00	0.00	-0.17	0.00	1.21	13.49
end	-0.540	1.030	0.000	0.00	0.00	0.00	0.00	-0.54	0.00	0.00	-0.54	12.95
Total	**0.430**	**6.425**	**-0.045**	**2.91**	**-2.48**	**15.04**	**-2.72**	**-0.54**	**0.01**	**0.73**	**12.95**	**12.95**
end	0.000	1.030	0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.49
Total	**0.970**	**6.425**	**-0.045**	**2.91**	**-2.48**	**15.04**	**-2.72**	**0.00**	**0.01**	**0.73**	**13.49**	**13.49**

Meggett SUVs include two punt returns in Buf-01 (in Nyg-01, 20 yards from Nyg 11 for +1.21) and Buf-09 (in Nyg-10, 17 yards from Nyg 13 for +1.03).

Buf Summary												
DRIVE	**Kelly**	**Thomas**	**Reed**	**kick**	**run**	**pass**	**pen.**	**kneel**	**punt**	**FG**	**SUM**	**CUMU**
01	-0.845	0.000	-0.345	1.21	0.00	-1.19	0.00	0.00	-0.89	0.00	-0.87	-0.87
02	-0.305	-0.080	0.000	1.53	-0.08	1.97	0.00	0.00	0.00	0.28	3.70	2.83
03	1.475	0.850	1.865	0.00	2.75	3.87	0.10	0.00	0.00	0.00	6.72	9.55
04	1.190	0.980	-1.230	0.00	-0.71	-0.04	0.40	0.00	0.14	0.00	-0.21	9.34
05	-3.240	0.000	0.000	0.91	0.00	-3.24	0.00	0.00	1.88	0.00	-0.45	8.89
06	-0.270	1.705	-0.365	0.00	1.23	-0.04	-0.50	0.00	-0.59	0.00	0.10	8.99
half	-0.660	0.000	0.000	0.66	0.00	0.00	0.00	-0.66	0.00	0.00	0.00	8.99
07	-2.730	0.300	0.000	1.99	-2.54	0.11	-1.61	0.00	0.94	0.00	-1.11	7.88
08	0.220	3.165	0.000	0.00	3.68	0.44	0.00	0.00	0.00	0.00	4.12	12.00
09	-1.580	0.650	0.000	0.78	-0.53	-0.74	0.00	0.00	1.88	0.00	1.39	13.39
10	0.440	2.610	0.070	0.00	3.30	0.00	0.00	0.00	0.00	-3.81	-0.51	12.88
Total	**-6.305**	**10.180**	**-0.005**	**7.08**	**7.10**	**1.14**	**-1.61**	**-0.66**	**3.36**	**-3.53**	**12.88**	**12.88**
half	0.000	0.000	0.000	0.66	0.00	0.00	0.00	0.00	0.00	0.00	0.66	13.54
Total	**-5.645**	**10.180**	**-0.005**	**7.08**	**7.10**	**1.14**	**-1.61**	**0.00**	**3.36**	**-3.53**	**13.54**	**13.54**

Table 10. SUVs for "Composite" Players from Two Example Games - Winning and Losing Quarterbacks, Running Backs and Wide Receivers

Player	Pittsburgh at Kansas City		NY Giants vs. Buffalo		Cumulative		Average SUV
	"Plays"	SUV	"Plays"	SUV	"Plays"	SUV	
Roethstetler	34	-13.700	38	0.970	72	-12.730	-0.177
Smelly	37	-12.985	35	-5.645	72	-18.630	-0.259

Bellett	32	5.815	16	6.425	48	12.240	0.255
Hillmas	12	3.525	20	10.180	32	13.705	0.428
Brovaro	8	4.860	6	-0.045	14	4.815	0.344
Kreed	6	1.025	9	-0.005	15	1.020	0.068

A.1.1 Summary

For these examples, we decided to form a set of "composite" players, consisting of the winning and losing quarterbacks, running backs and wide receivers from the two games, as shown in Table 10: (1) winning quarterbacks = Roethlisberger + Hostetler = Roesthstetler, (2) losing quarterbacks = Smith + Kelly = Smelly, (3) winning running backs = Bell + Meggett = Bellett, (4) losing running backs = Hill + Thomas = Hillmas, (5) winning wide receivers = Brown + Bavaro = Brovaro, and (6) losing wide receivers = Kelce + Reed = Kreed. "Plays" includes all entries for each player, including penalties due to the player.

It is likely inappropriate to compare players from different positions (e.g., quarterbacks can accrue negative SUVs quickly with just a few incompletions, while running backs and wide receivers only can do so when losing yardage relative to the line of scrimmage, not too common). Therefore, for the quarterbacks, it is clear that both cumulatively and on average, Roethstetler was more productive (less unproductive?) than Smelly. The case is not as clear for the running backs, as their cumulative SUVs are about equal. However, clearly Hillmas, the "losing" running back with 33% less "plays," has the noticeably higher average SUV, indicative of better performance "per play." The wide receiver comparison clearly favors Brovaro in both categories.

III. SUV Football: "Proof of Principle"

As with major league baseball, the goal here is again "Proof of Principle" by tracking the performance of an individual team (offense only) over a substantial portion of an entire season (16 games). One-third of the 2017 season, i.e., five games, have been selected for the Seattle Seahawks, starting with Game 02 and tracking every third game up through Game 14. The SUVs are based on the play-by-play descriptions provided in Reference 10. The complete play-by-play for the Seahawks' offensive possessions are provided for the following five games in Reference 3: (1) Game 02, San Francisco 49ers [9] @ Seattle [12], 09/17/2017; (2) Game 05, Seattle [16] @ Los Angeles Rams [10], 10/08/2017; (3) Game 08, Washington Redskins [17] @ Seattle [14], 11/02/2017; Game 11, Seattle [24] @ San Francisco 49ers [13], 11/23/2017; and (5) Los Angeles Rams [42] @ Seattle [7], 12/14/2017.

In Reference 3, for each play, the starting and finishing SUV are provided, with the difference allocated to the appropriate player(s). Special treatments other than the following are highlighted in ***bold purple italics*** with the play (e.g., see 2nd and 10 from the Sea 36 during Drive 01 in Game 02 as an example in Table 11). Plays involving penalties are highlighted in yellow. The following are not automatically highlighted but should be noted as they are standard practice throughout.

A. Passing

Completed passes have the change in SUV split 50/50 between the quarterback and receiver. Incomplete passes have the change in SUV assigned exclusively to the quarterback. The overall result is that quarterbacks tend to have negative SUVs, so cannot be compared against other players on their team.

B. Turnovers

When Seattle obtains possession via a turnover, the starting SUV is the negative of the opponent's SUV where the turnover occurs. The finishing SUV is that where Seattle starts its drive. For example, Drive 03 for Seattle vs. San Francisco in Game 02 (see Table 11) began with an interception at the SFr 43 (SUV = -1.67 for Sea), returned to the SFr 36 (SUV = 2.94), representing an SUV gain of 2.94 – (-1.67) = 4.61. When Seattle yields possession via a turnover, the starting SUV is that for where Seattle began its play. The finishing SUV is the negative of the opponent's SUV where they start their drive. For example, Drive 04 in Game 08 ended when Wilson was intercepted on 3rd and 4 from the Was 49 (starting SUV = 1.66), with Washington taking over at their own 43 (finishing SUV = -1.67), representing an SUV loss of 1.66 – (-1.67) = 3.33. This is shown in Table 12.

C. Kick Returns

On kick returns, the starting SUV is that where the kick is first fielded (assumed to be 0.59, corresponding to 1st and 10 at the Sea 25 if a kickoff is fielded in the end zone where a touchback could be chosen) and the finish where the play ends. On kickoff returns, this often results in an SUV loss if the kick is fielded in the end zone but not returned to at least the Sea 25 (e.g., see start of Drive 11 in Game 02, illustrated in Table 13).

D. Touchdowns

As highlighted in ***bold purple italics***, touchdowns are assumed to have an SUV = 7.00 (see Table 12). Six-sevenths of the difference between 7.00 and the starting SUV is assigned to the player(s) scoring the touchdown. If an extra point is converted, the kicker receives the remaining one-seventh (or the player[s] scoring on a successful two-point conversion earns this plus an additional 1.00). A missed conversion costs a kicker this one-seventh (or a player[s] this one-seventh + 1.00 if a two-point conversion fails). A special category, "No XP," is reserved strictly for touchdowns in overtime when no extra point is attempted.

E. SUV Analyses

Football offers more variations than baseball, so anticipating every possible SUV outcome is difficult. Analysis of these five games presented some unique challenges in addition to the above, and these are highlighted in ***bold purple italics*** with the play. Seattle both scored (Game 08, Drive 02 [see Table 12]) and yielded safeties (Game 14, Drive 13 [see Table 14]), and their treatments are described with the plays.

All players' SUVs were tracked cumulatively through the five games, as summarized in Table 15. Quarterbacks, kickers (punters and place kickers), and kick returners accrue SUVs quite differently from the other offensive players (runners and receivers) and are not readily comparable with them. Similarly, SUVs acquired by defensive players via turnovers are infrequent and usually very positive so as not to be comparable with offensive players. Penalties are their own unique category. Therefore, while all of these are tracked, for comparison purposes within the Seattle offense itself, only runners and receivers are considered. Over the span of the five games analyzed, only the following eight runners and receivers had enough plays (at least 14) to merit comparison: P. Richardson, Baldwin, Graham, Lockett (excluding kick returns), McKissic, Carson, Rawls and Lacy. The season statistics for these eight players were tabulated as well from the 2017 Full Season Statistics (Offense) provided for the Seahawks in Reference 10. (Mike Davis was included with the players selected for the full season statistics, but excluded from the comparison since he did not have enough plays in the five games analyzed for SUV [only eight plays].) The cumulative SUVs and traditional statistics for these eight players are presented in Table 16.

F. Comparison vs. "Traditional" Statistics

As before for baseball, the statistics for the various categories were normalized, then these normalized values were averaged (see Reference 1). A summary of the technique is repeated here.

The totals for the group of eight players, along with the mean and standard deviation in each category, "Cumulative SUV" and "SUV per Play" (or, for traditional statistics, "Total Pts" and "Total Yds," since these are the only categories common to all eight players), are calculated to enable a normalization of the statistics for each of the eight players as follows:

$$Normalized\ Statistic\ (Cumulative\ SUV\ or\ SUV\ Per\ Play) = \int_{-\infty}^{x} \frac{1}{\sigma\sqrt{2\pi}} e^{-\left(\frac{[x-\mu]^2}{2\sigma^2}\right)} dx$$

where μ = mean and σ = standard deviation.

These normalized statistics, representing the percentiles of the normal distribution where the statistics occur, are calculated for both "Cumulative SUV" and "SUV per Play" for the eight players. These two normalized statistics for each player are then averaged ("Both" column) and used to rank the players from first through eighth.

As an example calculation, consider Baldwin, who has a Cumulative SUV = 6.683 and SUV per Play = 0.334. When normalized to the mean Cumulative SUV = 3.662 and mean SUV per Play = 0.211 (with respective standard deviations of 2.911 and 0.178), his normalized Cumulative SUV and SUV per Play become as follows:

$$Normalized\ Cumulative\ SUV = \int_{-\infty}^{6.683} \frac{1}{(2.911)\sqrt{2\pi}} e^{-\left(\frac{[6.683-3.662]^2}{2[2.911]^2}\right)} dx = 0.850$$

$$Normalized\ SUV\ per\ Play = \int_{-\infty}^{0.334} \frac{1}{(0.178)\sqrt{2\pi}} e^{-\left(\frac{[0.334-0.211]^2}{2[0.178]^2}\right)} dx = 0.756$$

These indicate that his Cumulative SUV occurs at the 85.0%ile and SUV per Play at the 75.6%ile, both the second highest among the eight players. The average of the two is 0.803, which ranks him second, essentially midway between P. Richardson and Graham.

For the SUV comparison, two statistics were considered: Cumulative SUV and SUV per Play, as with baseball, corresponding to both longevity and "per Opportunity (Play)," respectively. For the full season statistics comparison, five statistics were considered: for longevity, Total Points, Total Yards, and Total Rushing Attempts + Receptions; for "per Play," Average Yards per Rushing Attempt and Average Yards per Reception. The results from the comparison of the normalized statistics are presented in Table 15.

The comparison is quite revealing, in that no player differs in rank between the SUV and full season comparison by more than one position (excluding Mike Davis, so only eight ranks are considered for the full season). P. Richardson and Baldwin occupy the top two position; Graham and McKissic the next two; Lockett and Carson positions five and six; and Rawls and Lacy the bottom pair. The SUV ranks are a bit more widespread (0.919 down to 0.061 vs. 0.835 down to 0.263), most likely because the sample size is smaller (only five of 16 games). Nonetheless, it is quite insightful to find this much consistency between the two sets of results, suggesting the simple SUV can be a useful surrogate vs. the larger set of diverse statistics that are presently being tracked.

Table 11. SUVs for First Three Offensive Series for Seattle vs. San Francisco, Game 02, Sept. 9, 2017 (from Reference 3)

Game 02: SFr-9 @ Sea-12, 09-17-2017	Start	Finish	Penalty	No XP	Wilson	Rawls	Prosise	Baldwin	Wagner	Sherman	Carson	Lockett	Darboh	Ryan	Walsh
Drive 01															
o (15:00 - 1st) B.Pinion kicks 65 yards from SF 35 to end zone, Touchback.		0.59													
o **1st and 10 at SEA 25**	0.59														
(15:00 - 1st) R.Wilson left end to SEA 26 for 1 yard (E.Reid).		0.25			-0.340										
o **2nd and 9 at SEA 26**	0.25														
(14:27 - 1st) T.Rawls right guard to SEA 27 for 1 yard (D.Buckner).		-0.09				-0.340									
o **3rd and 8 at SEA 27**	-0.09														
(13:50 - 1st) (Shotgun) R.Wilson pass short left to C.Prosise to SEA 36 for 9 yards (J.Ward).		1.25			0.670		0.670								
o **1st and 10 at SEA 36**	1.25														
(13:11 - 1st) (Shotgun) R.Wilson pass incomplete short left to J.Graham (J.Tartt).		0.75			-0.500										
o **2nd and 10 at SEA 36**	0.75														

Game 02: SFr-9 @ Sea-12, 09-17-2017	**Start**	**Finish**	**Penalty**	**No XP**	**Wilson**	**Rawls**	**Prosise**	**Baldwin**	**Wagner**	**Sherman**	**Carson**	**Lockett**	**Darboh**	**Ryan**	**Walsh**
(13:07 - 1st) R.Wilson FUMBLES (Aborted) at SEA 31, recovered by SEA-T.Rawls at SEA 35. T.Rawls to SEA 35 for no gain (S.Thomas). ***[Wilson lost 5 yds to 31 (SUV = -0.55); Rawls gained 4 yds to 35.]***		0.09			-1.300	0.640									
o **3rd and 11 at SEA 35**	0.09														
(13:07 - 1st) (Shotgun) PENALTY on SF-E.Dumervil, Neutral Zone Infraction, 5 yards, enforced at SEA 35 - No Play.		0.89	0.800												
o **3rd and 6 at SEA 40**	0.89														
(12:18 - 1st) (Shotgun) R.Wilson pass short left to D.Baldwin pushed ob at 50 for 10 yards (D.Johnson).		2.09			0.600			0.600							
o **1st and 10 at 50**	2.09														
(11:55 - 1st) R.Wilson pass short right to D.Baldwin to SF 48 for 2 yards		1.92			-0.085			-0.085							

Game 02: SFr-9 @ Sea-12, 09-17-2017	**Start**	**Finish**	**Penalty**	**No XP**	**Wilson**	**Rawls**	**Prosise**	**Baldwin**	**Wagner**	**Sherman**	**Carson**	**Lockett**	**Darboh**	**Ryan**	**Walsh**
(E.Reid).															
o **2nd and 8 at SF 48**	1.92														
(11:30 - 1st) (Shotgun) R.Wilson pass incomplete short left to P.Richardson.		1.42			-0.500										
o **3rd and 8 at SF 48**	1.42														
(11:26 - 1st) (Shotgun) R.Wilson pass short left to C.Carson to SF 41 for 7 yards (J.Ward; K.Williams).		0.91			-0.255						-0.255				
o **4th and 1 at SF 41**	0.91														
(10:53 - 1st) (Shotgun) R.Wilson left end ran ob at SF 32 for 9 yards (J.Tartt).		3.24			2.330										
o **1st and 10 at SF 32**	3.24														
(10:24 - 1st) C.Carson left tackle to SF 29 for 3 yards (R.Armstrong; A.Armstead).		3.28									0.040				
o **2nd and 7 at SF 29**	3.28														
(9:48 - 1st) (Shotgun) R.Wilson pass deep right to		5.30			1.010							1.010			

Game 02: SFr-9 @ Sea-12, 09-17-2017	**Start**	**Finish**	**Penalty**	**No XP**	**Wilson**	**Rawls**	**Prosise**	**Baldwin**	**Wagner**	**Sherman**	**Carson**	**Lockett**	**Darboh**	**Ryan**	**Walsh**
T.Lockett to SF 7 for 22 yards (K.Williams). Penalty on SF-A.Armstead, Defensive Holding, declined.															
o **1st and Goal at SF 7**	5.30														
(9:34 - 1st) T.Rawls left tackle to SF 7 for no gain (A.Armstead; T.Carradine).		5.10				-0.200									
o **2nd and Goal at SF 7**	5.10														
(8:53 - 1st) (Shotgun) R.Wilson pass incomplete short middle to C.Prosise.		4.60			-0.500										
o **3rd and Goal at SF 7**	4.60														
(8:49 - 1st) (Shotgun) R.Wilson pass incomplete short left to D.Baldwin.		1.98			-2.620										
o **4th and Goal at SF 7**	1.98														
(8:38 - 1st) Blair Walsh 25 Yd Field Goal		3.00													1.020
DRIVE NET (SUV: Finish minus Start & Sum of Players)	**2.41**	**2.41**	**0.800**	**0.000**	**-1.490**	**0.100**	**0.670**	**0.515**	**0.000**	**0.000**	**-0.215**	**1.010**	**0.000**	**0.000**	**1.020**
DRIVE 02 (SFr-9 @ Sea-12, 09-17-	**Start**	**Finish**	**Penalty**	**No XP**	**Wilson**	**Rawls**	**Prosise**	**Baldwin**	**Wagner**	**Sherman**	**Carson**	**Lockett**	**Darboh**	**Ryan**	**Walsh**

Game 02: SFr-9 @ Sea-12, 09-17-2017	**Start**	**Finish**	**Penalty**	**No XP**	**Wilson**	**Rawls**	**Prosise**	**Baldwin**	**Wagner**	**Sherman**	**Carson**	**Lockett**	**Darboh**	**Ryan**	**Walsh**
2017)															
(7:15 - 1st) B.Pinion punts 49 yards to SEA 17, Center-K.Nelson, fair catch by T.Lockett.	0.10	0.10										0.000			
o **1st and 10 at SEA 17**	0.10														
(7:07 - 1st) C.Carson right tackle to SEA 19 for 2 yards (N.Bowman).		-0.08									-0.180				
o **2nd and 8 at SEA 19**	-0.08														
(6:32 - 1st) R.Wilson sacked at SEA 18 for -1 yards (A.Lynch).		-0.74			-0.660										
o **3rd and 9 at SEA 18**	-0.74														
(5:54 - 1st) (Shotgun) R.Wilson pass incomplete deep left to T.Lockett.		-3.20			-2.460										
o **4th and 9 at SEA 18**	-3.20														
(5:50 - 1st) J.Ryan punts 54 yards to SF 28, Center-T.Ott. T.Taylor to SF 39 for 11 yards (D.McDonald).		-1.43												1.770	
DRIVE NET (SUV: Finish minus Start & Sum of Players)	**-1.53**	**-1.53**	**0.000**	**0.000**	**-3.120**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**-0.180**	**0.000**	**0.000**	**1.770**	**0.000**
CUMULATIVES	**0.88**	**0.88**	**0.800**	**0.000**	**-4.610**	**0.100**	**0.670**	**0.515**	**0.000**	**0.000**	**-0.395**	**1.010**	**0.000**	**1.770**	**1.020**

Game 02: SFr-9 @ Sea-12, 09-17-2017	**Start**	**Finish**	**Penalty**	**No XP**	**Wilson**	**Rawls**	**Prosise**	**Baldwin**	**Wagner**	**Sherman**	**Carson**	**Lockett**	**Darboh**	**Ryan**	**Walsh**
(SUV: Finish minus Start & Sum of Players)															
DRIVE 03 (SFr-9 @ Sea-12, 09-17-2017)	**Start**	**Finish**	**Penalty**	**No XP**	**Wilson**	**Rawls**	**Prosise**	**Baldwin**	**Wagner**	**Sherman**	**Carson**	**Lockett**	**Darboh**	**Ryan**	**Walsh**
(5:39 - 1st) (Shotgun) B.Hoyer pass short middle intended for C.Hyde INTERCEPTED by B.Wagner at SF 43. B.Wagner to SF 36 for 7 yards (M.Goodwin). FUMBLES (M.Goodwin), recovered by SEA-R.Sherman at SF 36. R.Sherman to SF 36 for no gain (C.Hyde). ***[Wagner intercepts at SFr 43 (-1.67) and returns to SFr 36 (2.94). Sherman recovers Wagner fumble for no gain.]***	-1.67	2.94							4.610	0.000					
o **1st and 10 at SF 36**	2.94														
(5:31 - 1st) (Shotgun) R.Wilson sacked at SF 44 for -8 yards (T.Carradine).		1.16			-1.780										
o **2nd and 18 at SF 44**	1.16														

Game 02: SFr-9 @ Sea-12, 09-17-2017	**Start**	**Finish**	**Penalty**	**No XP**	**Wilson**	**Rawls**	**Prosise**	**Baldwin**	**Wagner**	**Sherman**	**Carson**	**Lockett**	**Darboh**	**Ryan**	**Walsh**
(4:52 - 1st) (Shotgun) T.Rawls left tackle to SF 37 for 7 yards (N.Bowman).		1.78				0.620									
o **3rd and 11 at SF 37**	1.78														
(4:31 - 1st) R.Wilson pass short middle to A.Darboh to SF 21 for 16 yards (D.Johnson; J.Tartt) [D.Buckner].		4.12			1.170								1.170		
o **1st and 10 at SF 21**	4.12														
(4:01 - 1st) T.Rawls left guard to SF 21 for no gain (S.Thomas).		3.62				-0.500									
o **2nd and 10 at SF 21**	3.62														
(3:26 - 1st) (Shotgun) R.Wilson pass short right to T.Lockett to SF 13 for 8 yards (R.Robinson).		4.26			0.320							0.320			
o **3rd and 2 at SF 13**	4.26														
(3:26 - 1st) (Shotgun) R.Wilson pass short middle to T.Lockett to SF 7 for 6 yards (N.Bowman; E.Reid).		5.30			0.520							0.520			

Game 02: SFr-9 @ Sea-12, 09-17-2017	**Start**	**Finish**	**Penalty**	**No XP**	**Wilson**	**Rawls**	**Prosise**	**Baldwin**	**Wagner**	**Sherman**	**Carson**	**Lockett**	**Darboh**	**Ryan**	**Walsh**
o **1st and Goal at SF 7**	5.30														
(2:14 - 1st) T.Rawls right end to SF 11 for -4 yards (N.Bowman).		4.32				-0.980									
o **2nd and Goal at SF 11**	4.32														
(1:39 - 1st) R.Wilson pass short left to D.Baldwin to SF 9 for 2 yards (R.Robinson).		4.20			-0.060			-0.060							
o **3rd and Goal at SF 9**	4.20														
(0:57 - 1st) (Shotgun) R.Wilson pass incomplete short middle to T.McEvoy (K.Williams).		1.24			-2.960										
o **4th and Goal at SF 9**	1.24														
(0:49 - 1st) Blair Walsh 27 Yd Field Goal		3.00													1.760
DRIVE NET (SUV: Finish minus Start & Sum of Players)	**4.67**	**4.67**	**0.000**	**0.000**	**-2.790**	**-0.860**	**0.000**	**-0.060**	**4.610**	**0.000**	**0.000**	**0.840**	**1.170**	**0.000**	**1.760**
CUMULATIVES (SUV: Finish minus Start & Sum of Players)	**5.55**	**5.55**	**0.800**	**0.000**	**-7.400**	**-0.760**	**0.670**	**0.455**	**4.610**	**0.000**	**-0.395**	**1.850**	**1.170**	**1.770**	**2.780**

Table 12. SUVs for Seattle Drives 02 and 04 in Game 08, vs. Washington, Nov.2, 2017

DRIVE 02 (Was-17 @ Sea-14, 11-02-2017)	**Start**	**Finish**	**Penalty**	**Wilson**	**Baldwin**	**Lockett**	**Ryan**	**Walsh**	**Lacy**	**Jones**
(8:26 - 1st) K.Cousins FUMBLES (Aborted) at WAS 47, RECOVERED by SEA-N.Jones at WAS 42. N.Jones to WAS 42 for no gain (C.Roullier). ***[Jones recovers fumble at Was 42 (-1.61 to 2.58).]***	-1.61	2.58								4.190
o **1st and 10 at WSH 42**	2.58									
(8:21 - 1st) (Shotgun) E.Lacy left tackle to WAS 40 for 2 yards (Z.Brown; S.McGee).		2.40							-0.180	
o **2nd and 8 at WSH 40**	2.40									
(7:48 - 1st) E.Lacy left tackle to WAS 39 for 1 yard (S.McGee; P.Smith).		2.06							-0.340	
o **3rd and 7 at WSH 39**	2.06									
(7:08 - 1st) (Shotgun) R.Wilson pass incomplete short left to J.Graham [A.Lanier].		0.90		-1.160						
o **4th and 7 at WSH 39**	0.90									
(7:03 - 1st) J.Ryan punts 33 yards to WAS 6, Center-T.Ott, downed by SEA-L.Willson.		0.60					-0.300			
o **1st and 10 at WSH 6** ***[Was on offense, but SUV assigned as negative of offesnive value, i.e., -(-0.60).]***	0.60									
(6:48 - 1st) Kirk Cousins sacked in the end zone by Bobby Wagner for a Safety [***Included with Drive 02 since Safety occurred on first play after punt.]***		2.00								
DRIVE NET (SUV: Finish minus Start & Sum of Players)	**3.61**	**3.61**	**0.000**	**-1.160**	**0.000**	**0.000**	**-0.300**	**0.000**	**-0.520**	**4.190**
CUMULATIVES (SUV: Finish minus Start & Sum of Players)	**2.07**	**2.07**	**-1.600**	**-4.240**	**0.390**	**0.000**	**2.450**	**0.000**	**-0.520**	**4.190**

DRIVE 04 (Was-17 @ Sea-14, 11-02-2017)	**Start**	**Finish**	**Penalty**	**Wilson**	**Baldwin**	**Lockett**	**Ryan**	**Walsh**	**Lacy**	**Jones**
(2:06 - 1st) T.Way punts 53 yards to SEA 24, Center-N.Sundberg. T.Lockett to SEA 45 for 21 yards (C.Carter).	0.53	2.40				1.870				
o **1st and 10 at SEA 45**	2.40									
(1:54 - 1st) E.Lacy left tackle to WAS 47 for 8 yards (D.Swearinger).		2.28							-0.120	
o **2nd and 2 at WSH 47**	2.28									
(1:54 - 1st) M.Tobin reported in as eligible. PENALTY on SEA, Illegal Substitution, 5 yards, enforced at WAS 47 - No Play.		1.77	-0.510							
o **2nd and 7 at SEA 48**	1.77									
(1:13 - 1st) (Shotgun) E.Lacy up the middle to WAS 49 for 3 yards (W.Compton).		1.66							-0.110	
o **3rd and 4 at WSH 49**	1.66									
(0:29 - 1st) (Shotgun) R.Wilson pass short middle intended for D.Baldwin INTERCEPTED by K.Fuller at WAS 43. K.Fuller to SEA 33 for 24 yards (D.Brown). The Replay Official reviewed the runner was not down by contact ruling, and the play was REVERSED. (Shotgun) R.Wilson pass short middle intended for D.Baldwin INTERCEPTED by K.Fuller at WAS 43. K.Fuller to WAS 43 for no gain (D.Baldwin).		-1.67		-3.330						

DRIVE NET (SUV: Finish minus Start & Sum of Players)	**-2.20**	**-2.20**	**-0.510**	**-3.330**	**0.000**	**1.870**	**0.000**	**0.000**	**-0.230**	**0.000**
CUMULATIVES (SUV: Finish minus Start & Sum of Players)	**-1.48**	**-1.48**	**-2.110**	**-8.485**	**1.145**	**2.600**	**2.450**	**-2.460**	**-0.210**	**4.190**

Table 13. SUVs for Seattle Drive 11 in Game 02 vs. San Francisco, Sept. 17, 2017

DRIVE 11 (SFr-9 @ Sea-12, 09-17-2017)	**Start**	**Finish**	**Penalty**	**Wilson**	**Rawls**	**Prosise**	**Baldwin**	**Wagner**	**Carson**	**Lockett**	**Willson**	**Darboh**	**Graham**	**P Richardson**	**Ryan**	**Walsh**
o 11:36 - 4th) B.Pinion kicks 66 yards from SF 35 to SEA -1. T.Lockett to SEA 18 for 19 yards (D.Watson; A.Colbert). ***[Start assumed to be at Sea 25 if accepting Touchback.]***	0.59	0.16								-0.430						
o **1st and 10 at SEA 18**	0.16															
(11:31 - 4th) (Shotgun) R.Wilson pass short right to T.Lockett to SEA 23 for 5 yards (K.Williams).		0.47		0.155						0.155						
o **2nd and 5 at SEA 23**	0.47															
(11:01 - 4th) (No Huddle, Shotgun) R.Wilson right end to SEA 27 for 4 yards (R.Armstrong).		0.21		-0.260												
o **3rd and 1 at SEA 27**	0.21															
(10:29 - 4th)		1.13		0.920												

DRIVE 11 (SFr-9 @ Sea-12, 09-17-2017)	**Start**	**Finish**	**Penalty**	**Wilson**	**Rawls**	**Prosise**	**Baldwin**	**Wagner**	**Carson**	**Lockett**	**Willson**	**Darboh**	**Graham**	**P Richardson**	**Ryan**	**Walsh**
R.Wilson scrambles right end ran ob at SEA 34 for 7 yards (E.Harold).																
o **1st and 10 at SEA 34**	1.13															
(9:55 - 4th) (No Huddle, Shotgun) R.Wilson pass short right to D.Baldwin to SEA 43 for 9 yards (R.Armstrong).		1.67		0.270			0.270									
o **2nd and 1 at SEA 43**	1.67															
(9:26 - 4th) (Shotgun) C.Carson left tackle to SF 43 for 14 yards (J.Ward).		2.52							0.850							
o **1st and 10 at SF 43**	2.52															
(8:53 - 4th) (Shotgun) R.Wilson scrambles right end to SF 38 for 5 yards (R.Robinson).		2.82		0.300												
o **2nd and 5 at SF 38**	2.82															
(8:32 - 4th) (No Huddle, Shotgun) PENALTY on		2.02	-0.800													

DRIVE 11 (SFr-9 @ Sea-12, 09-17-2017)	**Start**	**Finish**	**Penalty**	**Wilson**	**Rawls**	**Prosise**	**Baldwin**	**Wagner**	**Carson**	**Lockett**	**Willson**	**Darboh**	**Graham**	**P Richardson**	**Ryan**	**Walsh**
SEA-J.Britt, False Start, 5 yards, enforced at SF 38 - No Play.																
o **2nd and 10 at SF 43**	2.02															
(8:26 - 4th) R.Wilson scrambles left end ran ob at SF 32 for 11 yards (S.Thomas).		3.24		1.220												
o **1st and 10 at SF 32**	3.24															
(8:03 - 4th) (Shotgun) R.Wilson pass incomplete deep left to A.Darboh. PENALTY on SF-D.Johnson, Defensive Pass Interference, 20 yards, enforced at SF 32 - No Play.		4.84	1.600													
o **1st and 10 at SF 12**	4.84															
(7:58 - 4th) (Shotgun) C.Carson right guard to SF 9 for 3 yards (R.Armstrong; N.Bowman).		4.90							0.060							
o **2nd and 7 at SF 9**	4.90															
(7:19 - 4th)		4.40		-0.500												

DRIVE 11 (SFr-9 @ Sea-12, 09-17-2017)	**Start**	**Finish**	**Penalty**	**Wilson**	**Rawls**	**Prosise**	**Baldwin**	**Wagner**	**Carson**	**Lockett**	**Willson**	**Darboh**	**Graham**	**P Richardson**	**Ryan**	**Walsh**
(Shotgun) R.Wilson pass incomplete short right to C.Carson.																
o 3r**d and 7 at SF 9**	4.40															
(7:06 - 4th) (Shotgun) Paul Richardson 9 Yd pass from Russell Wilson ***[TD assumed to be worth 7.00, with 6/7 accrued to scorer(s) and 1/7 to XP.]***		7.00		1.114										1.114		
(Blair Walsh PAT failed) ***[XP credit deducted from Finish.]***	7.00	6.63														0.000
DRIVE NET (SUV: Finish minus Start & Sum of Players)	**6.04**	**6.04**	**0.800**	**3.219**	**0.000**	**0.000**	**0.270**	**0.000**	**0.910**	**-0.275**	**0.000**	**0.000**	**0.000**	**1.114**	**0.000**	**0.000**
CUMULATIVES (SUV: Finish minus Start & Sum of Players)	**6.87**	**6.87**	**1.660**	**-12.606**	**-0.760**	**0.815**	**1.465**	**4.610**	**-0.545**	**2.540**	**0.555**	**1.170**	**-0.170**	**1.664**	**3.690**	**2.780**

Table 14. SUVs for Seattle Drive 13 in Game 14 vs. L.A. Rams, Dec. 14, 2017

DRIVE 13 (LAR-42 @ Sea-7, 12-14-2017)	**Start**	**Finish**	**Penalty**	**Wilson**	**Baldwin**	**Lockett**	**Willson**	**Darboh**	**Graham**	**P Richardson**	**Ryan**	**Walsh**	**McEvoy**	**McKissic**	**Wilhoite**	**Davis**

DRIVE 13 (LAR-42 @ Sea-7, 12-14-2017)	**Start**	**Finish**	**Penalty**	**Wilson**	**Baldwin**	**Lockett**	**Willson**	**Darboh**	**Graham**	**P Richardson**	**Ryan**	**Walsh**	**McEvoy**	**McKissic**	**Wilhoite**	**Davis**
(10:30 - 4th) J.Hekker punts 49 yards to SEA 5, Center-J.McQuaide, downed by LA-S.Ebukam.		-0.70														
o **1st and 10 at SEA 5**	-0.70															
(10:14 - 4th) Penalty on Russell Wilson enfored in end zone for Safety. J.Ryan kicks 59 yards from SEA 20 to LA 21. P.Cooper pushed ob at SEA 49 for 30 yards (J.Coleman). ***[Safety (-2.00) is added onto change in possession to LAR at Sea 49 (-2.16).]***		-4.16	-3.460													
DRIVE NET (SUV: Finish minus Start & Sum of Players)	**-3.46**	**-3.46**	**-3.460**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
CUMULATIVES (SUV: Finish minus Start & Sum of Players)	**-12.65**	**-12.65**	**-8.900**	**-22.004**	**0.180**	**3.685**	**1.406**	**-0.010**	**-0.330**	**-0.605**	**10.560**	**0.469**	**-2.245**	**0.665**	**4.620**	**-0.140**

Table 15. Cumulative SUVs for Seattle Seahawks through Five Games, 02, 05, 08, 11 and 14, in 2017

Player	Cumulative SUV (Through 1 Game)	Number of Plays, with Penalties & XPs	SUV per Play
Seahawks	8.37	98	0.085
Walsh	2.780	3	0.927
P Richardson	1.664	2	0.832
Ryan	3.690	7	0.527
Prosise	0.815	3	0.272
Baldwin	1.465	6	0.244
Lockett	2.540	13	0.195
Willson	0.555	3	0.185
Penalty	1.050	9	0.117
Carson	1.565	20	0.078
Rawls	-0.760	6	-0.127
Wilson	-12.606	50	-0.252
Wagner	4.610	1	4.610
Darboh	1.170	1	1.170
Sherman	0.000	1	0.000
Graham	-0.170	1	-0.170
No XP			

Player	Cumulative SUV (Through 2 Games)	Number of Plays, with Penalties & XPs	SUV per Play
Seahawks	25.20	184	0.137
Walsh	7.130	7	1.019
Ryan	9.670	13	0.744
P Richardson	2.719	5	0.544
Baldwin	3.045	10	0.305
Lockett	4.575	19	0.241
Graham	1.175	7	0.168
McKissic	0.760	5	0.152
Carson	1.565	20	0.078
Lacy	0.195	10	0.020
Penalty	0.000	15	0.000
Rawls	-0.415	16	-0.026
Wilson	-32.991	94	-0.351
Thomas	12.120	2	6.060
Wagner	4.610	1	4.610
Thorpe	4.290	1	4.290
S Richardson	5.990	2	2.995
Darboh	1.170	1	1.170
Pocic	0.790	1	0.790
Prosise	0.815	3	0.272
Willson	0.555	3	0.185
Sherman	0	1	0.000
Vannet	-0.310	2	-0.155
McEvoy	-2.260	1	-2.260
No XP			

Player	Cumulative SUV (Through 3 Games)	Number of Plays, with Penalties & XPs	SUV per Play
Seahawks	24.40	290	0.084
Ryan	13.150	19	0.692
P Richardson	4.509	8	0.564
Baldwin	6.748	16	0.422
Lockett	8.460	29	0.292
Graham	3.455	12	0.288
McKissic	1.420	10	0.142
Walsh	0.940	10	0.094
Carson	1.565	20	0.078
Rawls	1.540	27	0.057
Lacy	-0.015	17	-0.001
Wilson	-41.201	153	-0.269
Penalty	-10.980	29	-0.379
Thomas	12.120	2	6.060
Thorpe	4.290	1	4.290
Jones	4.190	1	4.190
Wagner	6.010	2	3.005
S Richardson	5.990	2	2.995
Darboh	1.170	1	1.170
Pocic	0.790	1	0.790
Willson	1.412	4	0.353
Prosise	0.815	3	0.272
Sherman	0.000	1	0.000
Vannet	-0.310	2	-0.155
McEvoy	-1.670	2	-0.835
No XP			

Player	Cumulative SUV (Through 4 Games)	Number of Plays, with Penalties & XPs	SUV per Play

Player	Cumulative SUV (Through 5 Games)	Number of Plays, with Penalties & XPs	SUV per Play

Seahawks	37.43	379	0.099
Ryan	17.550	25	0.702
P Richardson	7.539	12	0.628
Graham	5.369	15	0.358
Baldwin	6.503	19	0.342
Lockett	10.440	38	0.275
McKissic	2.640	18	0.147
Carson	1.565	20	0.078
Rawls	1.540	27	0.057
Walsh	0.211	15	0.014
Lacy	-1.385	37	-0.037
Wilson	-46.784	193	-0.242
Penalty	-9.890	35	-0.283
Thomas	12.120	2	6.060
Thorpe	4.290	1	4.290
Jones	4.190	1	4.190
Wagner	10.570	3	3.523
S Richardson	5.990	2	2.995
Darboh	1.170	1	1.170
Pocic	0.790	1	0.790
Willson	1.412	4	0.353
Prosise	0.815	3	0.272
Sherman	0.000	1	0.000
McEvoy	-0.365	4	-0.091
Vannet	1.147	5	-0.155
No XP			

Seahawks	25.23	457	0.055
Ryan	29.210	34	0.859
P Richardson	7.144	14	0.510
Baldwin	6.683	20	0.334
Graham	5.039	16	0.315
Lockett	15.215	49	0.311
McKissic	5.005	27	0.185
Carson	1.565	20	0.078
Rawls	1.540	27	0.057
Walsh	0.680	16	0.043
Lacy	-1.385	37	-0.037
Wilson	-70.808	233	-0.304
Penalty	-20.420	43	-0.475
Thomas	12.120	2	6.060
Wilhoite	4.620	1	4.620
Thorpe	4.290	1	4.290
Jones	4.190	1	4.190
Wagner	10.570	3	3.523
S Richardson	5.990	2	2.995
Pocic	0.790	1	0.790
Darboh	1.160	2	0.580
Willson	2.818	5	0.564
Prosise	0.815	3	0.272
Sherman	0.000	1	0.000
Davis	-0.140	8	-0.0175
Vannet	1.147	5	-0.155
McEvoy	-2.610	5	-0.522
No XP			

Table 16. Comparison of SUVs and Selected Traditional Statistics, Including Composite Normalization, for Eight Running Backs and Receivers with Most Opportunities over Five Representative Games

Player	Cumulative SUV	SUV per Play
P Richardson	7.144	0.510
Baldwin	6.683	0.334
Graham	5.039	0.315
Lockett*	3.705	0.247
McKissic	5.005	0.185
Carson	1.565	0.078
Rawls	1.540	0.057
Lacy	-1.385	-0.037

Player	Avg-Rush	Avg-Rec	Total Pts	Total Yds	Att+Rec
Doug Baldwin		13.2	50	983	77
Paul Richardson		16.0	36	703	44
Tyler Lockett		12.3	18	613	55
Jimmy Graham		9.1	62	520	57
J.D. McKissic	4.1	7.8	18	453	80
Mike Davis	3.5		0	371	83
Chris Carson	4.2		6	267	56
Thomas Rawls	2.7		0	251	67

Mean	**3.662**	**0.211**
Std Dev	**2.911**	**0.178**

Eddie Lacy	**2.6**		**0**	**226**	**75**
Mean	**3.42**	**11.68**	**21.1**	**487.4**	**66.0**
StdDev	**0.75**	**3.27**	**23.2**	**249.1**	**13.6**

Normalized	**Cumulative**	**per**	**Both**
P Richardson	**0.884**	**0.954**	**0.919**
Baldwin	**0.850**	**0.756**	**0.803**
Graham	**0.682**	**0.721**	**0.701**
McKissic	**0.678**	**0.442**	**0.560**
Lockett*	**0.506**	**0.580**	**0.543**
Carson	**0.236**	**0.227**	**0.231**
Rawls	**0.233**	**0.193**	**0.213**
Lacy	**0.041**	**0.081**	**0.061**

***Excludes Returns**

Normalized	**Avg-Rush**	**Avg-Rec**	**Total Pts**	**Total Yds**	**Att+Rec**	**Both**
Doug Baldwin		**0.679**	**0.893**	**0.977**	**0.791**	**0.835**
Paul Richardson		**0.906**	**0.739**	**0.807**	**0.053**	**0.626**
J.D. McKissic	**0.817**	**0.118**	**0.447**	**0.445**	**0.849**	**0.535**
Jimmy Graham		**0.216**	**0.961**	**0.552**	**0.254**	**0.496**
Mike Davis	**0.542**		**0.182**	**0.320**	**0.895**	**0.485**
Tyler Lockett		**0.576**	**0.447**	**0.693**	**0.209**	**0.481**
Chris Carson	**0.850**		**0.258**	**0.188**	**0.231**	**0.382**
Eddie Lacy	**0.138**		**0.182**	**0.147**	**0.746**	**0.303**
Thomas Rawls	**0.169**		**0.182**	**0.171**	**0.529**	**0.263**

Table 17. Selected 2015-16 Shooting Percentages for NCAA Men's Division I Basketball (from Reference 11)

rank	team	3-pt	rank	team	2-pt	rank	team	free
1	Michigan St	43.4%	1	Belmont	62.6%	1	Connecticut	79.3%
2	Oklahoma	42.2%	2	Villanova	57.4%	2	Villanova	78.2%
3	S Methodist	42.0%	3	Marshall	57.2%	3	Norfolk St	78.1%
4	Indiana	41.5%	4	Iowa State	56.7%	4	WI-Milwkee	77.5%
5	Kansas	41.3%	5	St Marys	56.4%	5	NW State	77.4%
6	St Marys	41.0%	6	Indiana	56.2%	6	St Bonavent	77.3%
7	Wofford	40.9%	7	Maryland	55.8%	7	Incarnate Word	77.1%
8	N Florida	40.9%	8	Utah	55.5%	8	Oakland	77.0%
9	IPFW	40.3%	9	E Washingtn	55.4%	9	Denver	77.0%
10	Virginia	40.2%	10	Richmond	55.4%	10	Maryland	76.9%
11	Oakland	39.8%	11	Weber State	55.3%	11	Monmouth	76.8%
12	Arkansas	39.7%	12	Wm & Mary	54.7%	12	Davidson	76.3%
13	E Kentucky	39.5%	13	N Florida	54.7%	13	High Point	76.0%
14	Butler	39.3%	14	Ste F Austin	54.5%	14	N Iowa	75.8%
15	Lehigh	39.3%	15	Creighton	54.5%	15	Gonzaga	75.8%
16	Middle Tenn	39.2%	16	Gonzaga	54.3%	16	Oral Roberts	75.7%
17	Harvard	39.1%	17	Denver	54.3%	17	Pittsburgh	75.6%

rank	team	3-pt	rank	team	2-pt	rank	team	free
18	Incarnate Word	38.9%	18	Furman	54.2%	18	Wofford	75.4%
19	Jacksonville	38.9%	19	E Kentucky	54.2%	19	Ohio	75.4%
20	USC	38.7%	20	Hawaii	54.1%	20	Geo Wshgtn	75.3%
21	Iowa State	38.7%	21	N Carolina	53.9%	21	Virginia	75.2%
22	Colorado	38.6%	22	Winthrop	53.9%	22	Albany	75.2%
23	Duke	38.5%	23	Boise State	53.7%	23	Georgetown	75.1%
24	E Washingtn	38.4%	24	Rice	53.4%	24	Winthrop	75.1%
25	BYU	38.4%	25	Massachusetts Lowell	53.2%	25	Neb Omaha	74.9%
26	Denver	38.3%	26	Evansville	53.2%	26	Rice	74.9%
27	E Tenn St	38.3%	27	Miami (FL)	53.2%	27	Miami (FL)	74.9%
28	Vanderbilt	38.2%	28	Duquesne	53.1%	28	Toledo	74.8%
29	Akron	38.2%	29	Notre Dame	52.9%	29	Hartford	74.8%
30	Vermont	38.2%	30	Kentucky	52.9%	30	Ste F Austin	74.8%
31	AR Lit Rock	38.2%	31	Purdue	52.8%	31	TN Tech	74.7%
32	Charlotte	38.2%	32	Portland St	52.7%	32	N Carolina	74.7%
33	Drake	38.2%	33	Kansas	52.7%	33	S Dakota St	74.7%
34	Ohio	38.2%	34	Oregon	52.6%	34	Illinois	74.6%
35	High Point	38.2%	35	Vermont	52.6%	35	Purdue	74.4%
36	Columbia	38.1%	36	UAB	52.6%	36	Texas Tech	74.2%
37	Princeton	38.1%	37	Miss State	52.6%	37	Notre Dame	74.2%
38	Arizona	38.1%	38	Virginia	52.6%	38	Mercer	74.2%
39	Oral Roberts	38.0%	39	Neb Omaha	52.6%	39	TX A&M-CC	74.1%
40	Michigan	38.0%	40	Elon	52.6%	40	Canisius	74.1%
316	Nicholls St	30.9%	316	NC A&T	44.8%	316	St Peters	65.8%
317	Presbyterian	30.8%	317	Georgia	44.7%	317	Nicholls St	65.7%
318	Miami (OH)	30.8%	318	Seattle	44.7%	318	California	65.6%
319	Jackson St	30.8%	319	Ark Pine Bl	44.7%	319	Maine	65.6%
320	Alcorn State	30.7%	320	Incarnate Word	44.7%	320	Hampton	65.6%
321	Hampton	30.5%	321	Indiana St	44.7%	321	WI-Grn Bay	65.6%
322	U Penn	30.4%	322	SE Missouri	44.6%	322	CS Bakersfld	65.4%
323	SIU Edward	30.4%	323	Arkansas St	44.5%	323	Gard-Webb	65.4%
324	IL-Chicago	30.4%	324	Florida A&M	44.4%	324	Cornell	65.3%
325	Loyola-MD	30.4%	325	SIU Edward	44.4%	325	Boston Col	65.1%
326	Florida A&M	30.4%	326	CS Fullerton	44.4%	326	Radford	65.1%
327	Miss Val St	30.3%	327	Auburn	44.3%	327	North Texas	65.1%
328	Ark Pine Bl	30.3%	328	Savannah St	44.2%	328	San Jose St	64.9%
329	St Fran (NY)	30.3%	329	St Johns	44.2%	329	Grambling St	64.8%
330	Cal St Nrdge	30.2%	330	Fla Atlantic	44.2%	330	Florida	64.8%
331	Old Dominion	30.1%	331	Colorado	43.9%	331	Quinnipiac	64.7%
332	Morgan St	30.1%	332	Bradley	43.9%	332	Alabama	64.3%
333	Chicago St	30.1%	333	New Orleans	43.8%	333	SC Upstate	64.2%
334	Tulane	30.0%	334	Delaware	43.7%	334	Bryant	64.2%

rank	team	3-pt	rank	team	2-pt	rank	team	free
335	Kansas St	30.0%	335	TX Christian	43.7%	335	Fla Gulf Cst	64.2%
336	Indiana St	29.9%	336	Alabama St	43.6%	336	UC Davis	64.0%
337	San Jose St	29.8%	337	Morgan St	43.6%	337	SE Louisiana	63.9%
338	LIU-Brooklyn	29.7%	338	Cleveland St	43.4%	338	SE Missouri	63.9%
339	Howard	29.5%	339	Howard	43.4%	339	Navy	63.8%
340	San Diego	29.2%	340	Jksnville St	43.2%	340	Troy	63.4%
341	Geo Mason	29.2%	341	App State	43.1%	341	Auburn	63.3%
342	Nevada	29.1%	342	Delaware St	42.4%	342	St Johns	63.2%
343	SE Missouri	28.8%	343	Central Conn	42.3%	343	TX Southern	63.1%
344	S Florida	28.6%	344	N Arizona	42.3%	344	Jackson St	63.0%
345	Binghamton	28.5%	345	Drexel	42.3%	345	IL-Chicago	61.9%
346	Alab A&M	28.4%	346	Prairie View	42.1%	346	Charl South	61.3%
347	Niagara	28.2%	347	Miss Val St	42.0%	347	Ark Pine Bl	61.1%
348	Bradley	27.7%	348	Chicago St	40.9%	348	Delaware St	60.9%
349	Rob Morris	27.6%	349	Coppin State	40.5%	349	Middle Tenn	60.6%
350	Grambling St	27.4%	350	IL-Chicago	40.3%	350	Harvard	59.0%
351	Prairie View	27.2%	351	Quinnipiac	38.3%	351	Florida A&M	58.9%
	mean	**34.54%**		**mean**	**48.66%**		**mean**	**69.89%**
	stdv	**2.80%**		**stdv**	**3.26%**		**stdv**	**3.45%**
	5th%	**30.05%**		**5th%**	**43.75%**		**5th%**	**64.20%**
stats	**95th%**	**38.90%**	**stats**	**95th%**	**54.20%**	**stats**	**95th%**	**75.40%**
	median	**34.5%**		**median**	**48.7%**		**median**	**69.7%**

IV. Introduction: SUV Basketball

SUV for NCAA Men's Division I basketball is developed from "first principles," beginning with the concept of the worth, in points, of a possession where there is an attempted score. Reference 11 lists the shooting percentages for 351 NCAA Men's teams for the NCAA season 2015-16. Excerpts from these are listed in Table 17, accompanied by their statistics, which are used to assign SUVs to the various plays. These statistics imply the following point values of each type of shot: (1) 3-pt shot = (3)(0.345) = 1.04 ≈ 1.0; (2) 2-pt shot = (2)(0.487) = 0.97 ≈ 1.0; and (3) free = (1)(0.699) = 0.7. If we assume a possession with an attempted score corresponds to either a 3- or 2-pt attempt, the value of a possession is ~ 1.0, which is also the value of a 3- or 2-pt attempt. A free throw is worth 0.7. A special case can be made for a lay-up/dunk in that it should have an even higher percentage for success than a free throw. A value of 80% seems reasonable (the midpoint between 70% for a free throw and an assumed 90% for an uncontested lay-up/dunk), making its value (2)(0.8) = 1.6.

V. SUV Basketball: Assignments for Plays

Based on these values, we can assign an SUV to a "make" or a "miss" for each, as follows:
3-pt "make" = 3.0 – 1.0 = +2.0; 3-pt "miss" = 0 – 1.0 = -1.0
2-pt "make" = 2.0 – 1.0 = +1.0; 2-pt "miss" = 0 – 1.0 = -1.0
free "make" = 1.0 – 0.7 = +0.3; free "miss" = 0 – 0.7 = -0.7
lay-up/dunk "make" = 2.0 – 1.6 = +0.4; lay-up/dunk "miss" = 0 – 1.6 = -1.6

A. Assists

For the lay-up/dunk, credit should be given for an "assist" that gets the ball right under the basket, whether this assist be from another player or the shooter himself. Consistent with the rest of the 2-pt shots, the value of a lay-up/dunk should be 1.0. Therefore, the "assist" should be +0.6, bringing the total SUV for a "made" lay-up/dunk to 0.4 + 0.6 = 1.0 and that for a "miss" to -1.6 + 0.6 = -1.0. Thus, a player who "drives" for a lay-up attempt earns 0.4 + 0.6 = 1.0 in SUV if successful, but loses -(-1.6 + 0.6) = 1.0 if he fails. Likewise, "assists" for 3- and 2-pt shots that are successful should be recognized. Thus, when either of these is "made," the SUV earned is split equally between the scorer and "assister" (i.e., +1.0 each on a successful 3-pt shot; +0.5 each on a 2-pt shot).

Consistent with the lay-up/dunk valuation, a "tap-in," by definition successful, is also worth an overall SUV of +1.0, but here the +0.4/+0.6 split goes to the shooter (who missed) and the "tapper" (who scored), i.e., the reverse of a successful lay-up/dunk. Of course, it the shooter taps in his own miss, he gets the full +1.0. For goaltending, if offensive, the goaltender, not the shooter, earns the -1.0. If defensive, then the shooter earns the full SUV (or half if there was an "assist") as if the shot was made without the goaltending. Rebounds, offensive or defensive, equate to gaining possession in a "free ball" situation, so are worth +1.0.

B. Turnovers, Fouls, Steals, etc.

A "self-induced" turnover, such as anything out of bounds, a clock violation, traveling, double-dribbling, getting "tied-up" and losing possession, changes your team's possession to that of the other team, with an SUV = -1.0 - 1.0 = -2.0. A defensive foul that results in two free throws for the opponent can have any of four results: (1) both shots missed, with a probability of $(0.3)^2 = 0.09$; (2) and (3) one shot made, one missed, with a probability of (2)(0.7)(0.3) = 0.42; and (4) both shots made, with a probability of $(0.7)^2 = 0.49$. As required, the probabilities sum to 1.0. Thus, the SUV for a defensive foul resulting in two shots becomes (0)(0.09) - (1)(0.42) - (2)(0.49) = -1.4. For a three-shot foul, it becomes $(0)(0.3)^3 – (1)(3)(0.7)(0.3)^2 – (2)(3)(0.7)^2(0.3) – (3)(0.7)3 = -2.1$ (note that there are three ways each to score only 1 point or 2). For a "1 + 1" situation, the SUV is $(0)(0.3) – (1)(0.7)(0.3) – (2)(0.7)^2 = -1.19 ≈ -1.2$. For non-shooting fouls, there is still a negative SUV as each one counts toward the opponent reaching the "1 + 1" bonus. After six such non-shooting fouls, the opponent earns a "1 + 1" on the seventh, so a reasonable SUV for a non-shooting foul is -1.2/7 or -1.4/7, both of which equate to ~ -0.2. Offensive fouls that yield opponent foul shots cost the fouler's team a possession, so the SUV is reduced by another 1.0, bringing the SUVs for a "1 + 1" and 2-shot free throw opportunity to -1.2 – 1.0 = -2.2 and -1.4 – 1.0 = -2.4, respectively. In a non-shooting situation, the offensive foul still costs the fouler's team possession and yields it to the opponent, so it equates the same as a turnover, i.e., - 2.0. A technical or intentional foul not only provides the 2-shot free throw opportunity, but costs possession after that, so there is an additional decrement of 1.0 in SUV, i.e., -2.4 – 1.0 = -3.4.

A steal is equivalent to a turnover, but it is not considered "self-induced." Therefore, the "stealee's" SUV is only -1.0 while the "stealer" earns +1.0. A successfully blocked shot, where there is a change of possession, yields a -1.0 SUV for the shooter (and is offset by the +1.0 for successfully rebounding the block). If the blocker recovers the ball, he earns the full +1.0 for possession change. If a teammate recovers, the SUV is split between the blocker (+0.5) and the "recoverer" (+0.5). Finally, breaking a full-court press changes a "contested" possession into an "actual" possession, so earns the "breaker" +1.0 SUV (which may be split if more than one player deserves the credit). The SUVs for all of these plays of these are summarized in Figure 4.

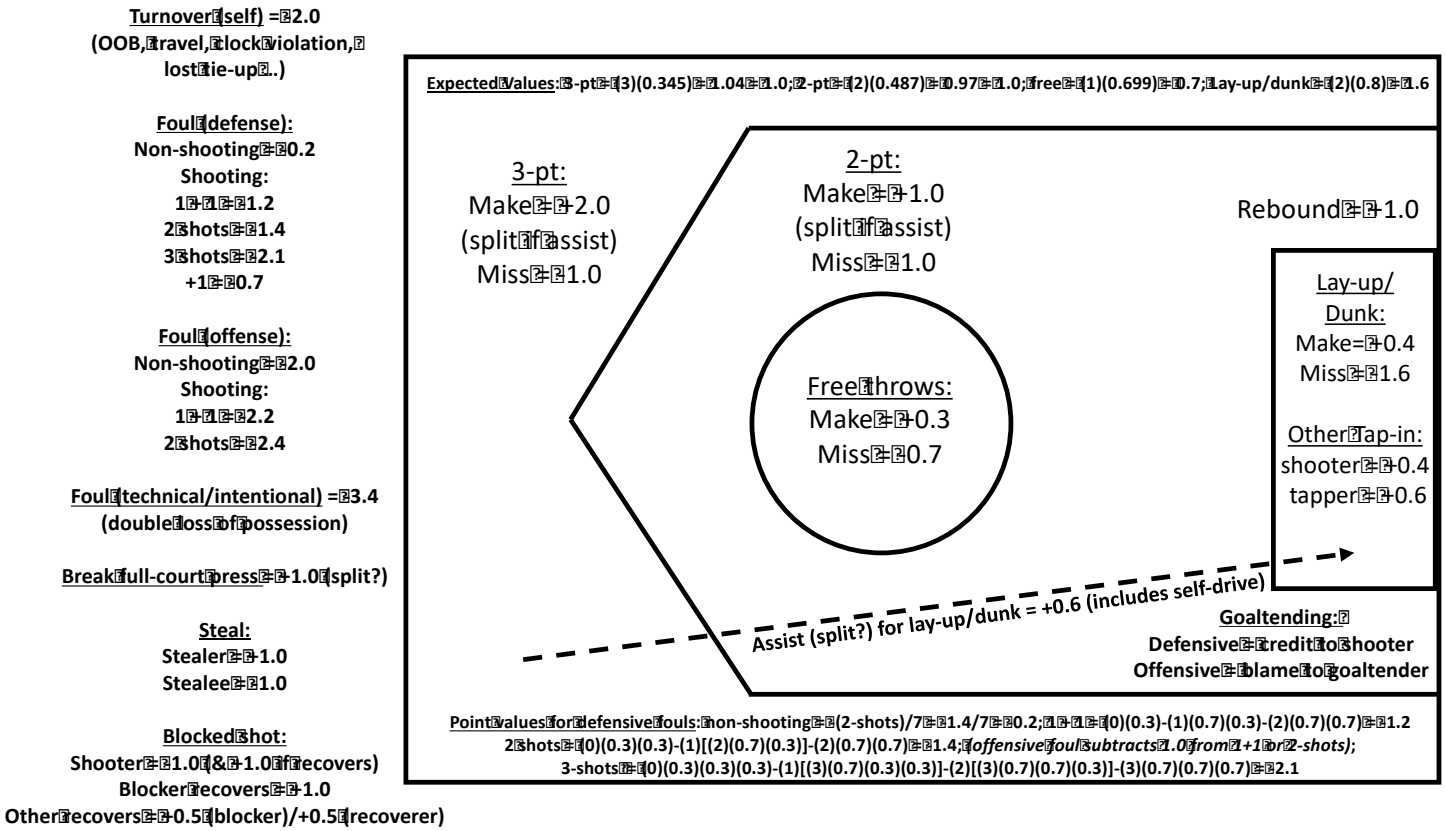

Figure 4. SUV Chart for NCAA Men's Division I Basketball

C. Real Game Examples

Two of the more recent NCAA Men's Championship games have been selected to illustrate the use of SUV for basketball (see References 12 and 13 for play-by-play). The first, Connecticut's 60-54 victory over Kentucky in 2014, illustrates a relatively low-scoring game. The second, Villanova's buzzer-beating 77-74 win over North Carolina in 2016, illustrates a fairly high-scoring game. Excerpts from both games, including final overall SUVs, are shown in Tables 18 and 19, including the overall SUVs for two players from each team (as shown by the yellow and green highlighting).

An illustrative series from 1:52 to 1:31 of the second half of the Villanova-North Carolina (Table 19) game demonstrates the use of the SUV for basketball:

1:52 –Justin Jackson commits personal foul (shooting, 2 shots) = -1.4 (Jackson [green highlight, since Jackson is a tracked player])
1:52 –Justin Hart misses first free throw (-0.7), but makes the second (+0.3), both in green highlight since Hart is a tracked player
1:38 –Mikal Bridges blocks Marcus Paige's 2-point lay-up, but North Carolina recovers = -1.0 (Paige [yellow highlight since Paige is a tracked player]))
1:31 –Marcus Paige makes 3-point jump shot with assist from Brice Johnson = +1.0 (Paige [yellow highlight]) and +1.0 (no highlight, since Johnson is not a tracked player)

A play at 0:09 from the first half of the same game illustrates a play where tracked players from both teams record SUVs. Josh hart blocks Justin Jackson's 2-point lay-up, earning a +1.0 for Hart and -1.0 for Jackson.

C.1 Summary

A parallel approach to that for football is also applied for the two example games here. This time, we combine the higher and lower scorers separately for the winner and losers as shown in Table 20: (1) winning higher scores = Napier + Booth = Nooth, (2) losing higher scorers = Young + Paige = Yaige, (3) winning lower scorers = Daniels + Hart = Dart, and (4) losing lower scorers = Harrison + Jackson = Harjack. "Plays" include shot attempts, assists, rebounds, fouls, etc.

Again, it may be inappropriate to compare all players together, as they have different roles which may give some more opportunities for positive SUVs (negative ones) than others. Still, since "play-makers" can get credits for positive non-shooting "plays," e.g., steals and assists; "rebounders/defenders" for positive "plays" such as rebounds, both offensive and defensive, blocks, and tap-ins; and, of course, "shooters" for 2- and 3-pointers; plus free throws for all, comparison among all four is more even than it

might be for football. In the examples, there is clear dominance in both cumulative and average SUV by Nooth, and clear "non-dominance" by Harjack. Both Yaige and Dart performed comparably, with a slight edge to Dart for amassing a similar cumulative SUV with less "plays" (indicated by the higher average.

VI. SUV Basketball: "Proof of Principle"

As with the "Proof of Principle" for baseball and football, the goal again is to track the performance of an individual team. However, rather than select a substantial portion of an entire season (typically around 30 games, excluding any post-season participation), here the five-game run of the Loyola of Chicago Ramblers through the 2018 NCAA Division I Men's Basketball Tournament is tracked, as it represents a complete microcosm for which the SUV results can be compared to the traditional overall statistics. Over those five games, Loyola won four to reach the Final Four as a Number 11 seed, defeating the following: (1) Miami of Florida 64-62 on March 15, 2018; (2) Tennessee 63-62 on March 17, 2018; (3) Nevada 69-68 on March 22, 2018; and (4) Kansas State 78-62 on March 24, 2018. Their run ended on March 31, 2018, with a loss to Michigan, 69-57. The play-by-play for Loyola for each of these games is taken from Reference 14, with a selected segment reproduced in Table 21 to show the assignment of the SUV statistics to the individual players. Reference 3 contains the complete SUV analyses for all five games.

An interesting and illustrative series for Loyola at the start of the second half of Game 2 vs. Tennessee (below) shows the assignment of the SUVs via Table 21. Cameron Krutwig is key to the first four plays. First, he misses a layup, an SUV of -1.6. However, since a layup is always scored either from an assist by another player or by the scorer himself driving to the basket (self-assist), an additional SUV of +0.6 is always associated with it. Since there is no indication in the play-by-play whether Krutwig's attempt was the result of another's assist or his own drive, the +0.6 is placed in the category "Unassigned," necessary since the missed shot must have a total SUV = -1.0 (as shown in the "Team" column). (Had Krutwig converted the layup, he would have received an SUV of +0.4 and the assister an SUV of +0.6 which, if Krutwig himself, e.g., on a drive, would have given him the full SUV of +1.0.) Krutwig subsequently misses (SUV = -0.7) then converts a free throw (SUV = +0.3), and later pulls down a defensive rebound (SUV = +1.0). Next, Marques Townes misses a three-point shot (SUV = -1.0) then, after a Donte Ingram defensive rebound (SUV = +1.0), converts a layup, assumed to be self-assisted since no other player is credited, as is typical for the play-by-play format when there is an assist. Thus, Townes receives both the layup scorer's SUV of +0.4 and that of the assister, +0.6, for the full total of +1.0.

Clayton Custer is key to the next three plays. First, he scores three points off an assist from Donte Ingram, splitting the SUV of +2.0 equally between both. He follows with an unassisted three-pointer, for full credit of +2.0. However, next he fouls, resulting in two shots for the opponent and an SUV of -1.4. The opponent missed the second free throw, and Ben Richardson pulled down the defensive rebound (SUV = +1.0). Krutwig subsequently committed an offensive foul, equivalent to a turnover, for an SUV = -2.0. Ingram next misses a three-pointer (SUV = -1.0). Finally, Richardson converts a two-pointer with an assist from Custer, splitting the SUV of +1.0 equally between them. Hopefully, the assignment of SUVs is fairly straightforward. Any anomalies are explained in ***bold purple italics*** with the play.

A. SUV Analyses

All players' SUVs were tracked cumulatively through the five games, as shown in Table 22.

B. Comparison vs. "Traditional" Statistics

To provide insights relative to the traditional statistics, the SUVs for the seven players with the most minutes over the five games (highlighted in yellow) are compared against their cumulative "traditional" statistics, compiled in Table 23. The statistics selected for comparison are shown in red, a total of nine in all, again representing both "longevity" ("MIN" = Minutes; "SUM+" = total of rebounds ["REB"], assists ["AS"], steals ["ST"] and blocks ["BLK"]; "Sum-" = total of turnovers ["TO"] and personal fouls ["PF"]; and total points scored ["PTS"]) and "per Opportunity" (field goal percentage [FG-%"], free throw percentage ["FT-%"], "SUM+" per Minute ["+PM" or "+/M"], "SUM-" per Minute ["-PM" or "-/M"] and points per Minute ["PPM" or "Pt/M"]). As before for both baseball and football, the statistics for the various categories were normalized, then these normalized values were averaged ("Comp" column). For the SUV comparison, two statistics were considered: Cumulative SUV and SUV per Opportunity, again corresponding to both longevity and "per Opportunity," respectively, and averaged ("Comp" column). The results from the comparison of the normalized statistics are presented in Table 23. The results show some significant differences in the rankings, particularly for Townes and Williamson. Townes ranks second using traditional statistics, but sixth using SUV. Williamson is the reverse, second using SUV but seventh for traditional. Richardson also stands out as quite a positive performer using the SUV.

Table 21. SUVs from Selected Play-by-Play for Loyola vs. Tennessee at Start of Second Half, March 17, 2018

Game 2, Loyola-Chi (63) vs. Tennessee (62), 03-17-2018		Custer	Ingram	Jackson	Krutwig	Negron	Richardson	Satterwhite	Skokna	Townes	Williamson	Unassigned	Team	
Cameron Krutwig misses two point layup ***(Unassigned assist credited)***	19:31				**-1.6**							**0.6**	**-1.0**	2
Cameron Krutwig misses regular free throw 1 of 2	18:57				**-0.7**								**-0.7**	1
Cameron Krutwig makes regular free throw 2 of 2	18:57				**0.3**								**0.3**	1
Cameron Krutwig defensive rebound after block	18:39				**1.0**								**1.0**	1
Marques Townes misses three point jump shot	18:26									**-1.0**			**-1.0**	1
Donte Ingram defensive rebound	18:01		**1.0**										**1.0**	1
Marques Townes makes two point reverse layup	17:52									**1.0**			**1.0**	1
Clayton Custer makes three point jump shot (Donte Ingram assists)	17:20	**1.0**	**1.0**										**2.0**	2
Donte Ingram makes three point pullup jump shot	16:56		**2.0**										**2.0**	1
Clayton Custer shooting foul (Jordan Bowden draws the foul) - 2 shots	16:39	**-1.4**											**-1.4**	1
Ben Richardson defensive rebound	16:39						**1.0**						**1.0**	1
Cameron Krutwig offensive foul	16:15				**-2.0**								**-2.0**	1

(Grant Williams draws the foul)													
Donte Ingram misses three point jump shot	15:35		**-1.0**										**-1.0**
Ben Richardson makes two point jump shot (Clayton Custer assists)	14:45	**0.5**					**0.5**						**1.0**
Ramblers turnover (shot clock violation)	13:48												
Aundre Jackson personal foul (Derrick Walker draws the foul) - no shot	13:36							**-0.2**					
Cameron Krutwig personal foul (Derrick Walker draws the foul) - no shot	13:26								**-0.2**				
Lucas Williamson makes three point jump shot (Cameron Krutwig assists)	12:26								**1.0**				
Ramblers defensive rebound	12:04												
Aundre Jackson makes two point layup (Cameron Krutwig assists)	11:42							**0.4**	**0.6**				
Aundre Jackson misses two point layup ***(Unassigned assist credited)***	11:01							**-1.6**					
Lucas Williamson defensive rebound	10:48												
Cameron Krutwig makes two point	10:36								**1.0**				

jump shot													
Marques Townes defensive rebound	10:10												
Bruno Skokna makes three point jump shot (Marques Townes assists)	10:03												
Aundre Jackson personal foul (Grant Williams draws the foul) - no shot	9:43							**-0.2**					
Cameron Krutwig misses two point layup	9:03								**-1.6**				

Table 22. Cumulative SUVs for Loyola through Each of Five NCAA Tournament Games

Game 1, Loyola-Chi (64) vs. Miami-FL (62), 03-15-2018	Custer	Ingram	Jackson	Krutwig	Negron	Richardson	Satterwhite	Skokna	Townes	Williamson	Unassigned	Team
Cumulatives (Game)	3.0	0.4	-6.0	1.0	0.0	6.3	-3.0	-0.8	-8.1	-1.2	7.2	-1.2
Number of Opportunities (Game)	17	26	15	17	0	17	3	2	17	15	10	113
SUV per Opportunity (Game)	0.18	0.02	-0.40	0.06		0.37	-1.00	-0.40	-0.48	-0.08	0.72	-0.01

Game 2, Loyola-Chi (63) vs. Tennessee (62), 03-17-2018	Custer	Ingram	Jackson	Krutwig	Negron	Richardson	Satterwhite	Skokna	Townes	Williamson	Unassigned	Team
Number of Opportunities (Game)	13	17	25	18	0	15	0	3	19	11	9	109
SUV per Opportunity (Game)	0.05	-0.12	-0.11	-0.18		0.02		0.20	0.34	0.38	0.49	0.08
Cumulatives (Thru 2 Games)	3.7	-1.7	-8.7	-2.3	0.0	6.6	-3.0	-0.2	-1.7	3.0	11.6	7.3
Number of Opportunities (Thru 2 Games)	30	43	40	35	0	32	3	5	36	26	19	222
SUV per Opportunity (Thru 2 Games)	0.12	-0.04	-0.22	-0.07		0.21	-1.00	-0.04	-0.05	0.12	0.61	0.03

Game 3, Loyola-Chi (69) vs. Nevada (68), 03-22-2018	Custer	Ingram	Jackson	Krutwig	Negron	Richardson	Satterwhite	Skokna	Townes	Williamson	Unassigned	Team
Cumulatives (Game)	0.9	-3.8	-0.6	1.0	0.0	-2.2	2.0	-5.2	-0.5	-2.0	12.2	1.8
Number of Opportunities (Game)	23	9	18	15	0	17	2	7	27	10	21	120
SUV per Opportunity (Game)	0.04	-0.42	-0.03	0.07		-0.13	1.00	-0.74	-0.02	-0.20	0.58	0.02
Cumulatives (Thru 3 Games)	4.6	-5.5	-9.3	-1.3	0.0	4.4	-1.0	-5.4	-2.2	1.0	23.8	9.1
Number of Opportunities (Thru 3 Games)	53	52	58	50	0	49	5	12	63	36	40	342
SUV per Opportunity (Thru 3 Games)	0.09	-0.11	-0.16	-0.03		0.09	-0.20	-0.45	-0.03	0.03	0.60	0.03

Game 4, Loyola-Chi (78) vs. KS St. (62), 03-24-2018	Custer	Ingram	Jackson	Krutwig	Negron	Richardson	Satterwhite	Skokna	Townes	Williamson	Unassigned	Team
Cumulatives (Game)	-4.8	4.0	1.5	4.5	0.0	9.5	-3.6	1.0	-3.1	1.4	4.0	14.4
Number of Opportunities	22	22	8	19	0	26	4	1	24	21	6	131

(Game)													
SUV per Opportunity (Game)		**-0.22**	**0.18**	**0.19**	**0.24**		**0.37**	**-0.90**	**1.00**	**-0.13**	**0.07**	**0.67**	**0.11**
Cumulatives (Thru 4 Games)		**-0.2**	**-1.5**	**-7.8**	**3.2**	**0.0**	**13.9**	**-4.6**	**-4.4**	**-5.3**	**2.4**	**27.8**	**23.5**
Number of Opportunities (Thru 4 Games)		**75**	**74**	**66**	**69**	**0**	**75**	**9**	**13**	**87**	**57**	**46**	**473**
SUV per Opportunity (Thru 4 Games)		**0.00**	**-0.02**	**-0.12**	**0.05**		**0.19**	**-0.51**	**-0.34**	**-0.06**	**0.04**	**0.60**	**0.05**

Game 5, Loyola-Chi (57) vs. Michigan (69), 03-31-2018	**Custer**	**Ingram**	**Jackson**	**Krutwig**	**Negron**	**Richardson**	**Satterwhite**	**Skokna**	**Townes**	**Williamson**	**Unassigned**	**Team**
Cumulatives (Game)	**-6.5**	**2.1**	**-2.9**	**-4.6**	**-1.0**	**-4.6**	**-0.4**	**-2.8**	**-3.6**	**-0.4**	**4.6**	**-20.1**
Number of Opportunities (Game)	**18**	**21**	**16**	**29**	**2**	**16**	**2**	**3**	**23**	**6**	**7**	**131**
SUV per Opportunity (Game)	**-0.36**	**0.10**	**-0.18**	**-0.16**	**-0.50**	**-0.29**	**-0.20**	**-0.93**	**-0.16**	**-0.07**	**0.66**	**-0.15**
Cumulatives (Thru 5 Games)	**-6.7**	**0.6**	**-10.7**	**-1.4**	**-1.0**	**9.3**	**-5.0**	**-7.2**	**-8.9**	**2.0**	**32.4**	**3.4**
Number of Opportunities (Thru 5 Games)	**93**	**95**	**82**	**98**	**2**	**91**	**11**	**16**	**110**	**63**	**53**	**604**
SUV per Opportunity (Thru 5 Games)	**-0.07**	**0.01**	**-0.13**	**-0.01**	**-0.50**	**0.10**	**-0.45**	**-0.45**	**-0.08**	**0.03**	**0.61**	**0.01**

Table 23. Comparison of SUVs and Selected Traditional Statistics, Including Composite Normalization, for Seven Loyola Players with Most Minutes over Five NCAA Tournament Games

NAME	Min	FG%	FT%	Sum+	+/M	Sum-	-/M	Pts	Pt/M	
Cameron Krutwig	109	0.58	0.73	38	0.35	-18	-0.06	52	0.48	
Aundre Jackson	89	0.58	1.00	16	0.18	-16	-0.11	59	0.66	
Clayton Custer	179	0.56	0.75	31	0.17	-20	-0.04	61	0.34	
Lucas Williamson	117	0.40	0.43	26	0.22	-13	-0.08	23	0.20	
Ben Richardson	168	0.54	0.80	44	0.26	-19	-0.08	41	0.24	
Marques Townes	147	0.49	0.92	41	0.28	-21	-0.06	54	0.37	
Donte Ingram	147	0.37	0.40	39	0.27	-19	-0.07	35	0.24	
Mean	136.6	0.50	0.72	33.6	0.25	-18.0	-0.07	46.4	0.36	
Std Dev	32.7	0.09	0.23	9.9	0.06	2.7	0.02	14.0	0.16	
Normalized										Comp
Cameron Krutwig	0.20	0.82	0.52	0.67	0.95	0.50	0.78	0.66	0.76	0.65
Marques Townes	0.63	0.44	0.81	0.77	0.70	0.13	0.69	0.71	0.52	0.60
Clayton Custer	0.90	0.76	0.55	0.40	0.11	0.23	0.89	0.85	0.45	0.57
Ben Richardson	0.83	0.66	0.64	0.85	0.60	0.36	0.40	0.35	0.24	0.55
Aundre Jackson	0.07	0.81	0.89	0.04	0.14	0.77	0.03	0.82	0.97	0.50
Donte Ingram	0.63	0.06	0.08	0.71	0.62	0.36	0.44	0.21	0.23	0.37
Lucas Williamson	0.27	0.12	0.10	0.22	0.34	0.97	0.41	0.05	0.16	0.29

Loyola Player		Cumu	SUV/Op	
Ben Richardson		9.3	0.10	
Lucas Williamson		2.0	0.03	
Donte Ingram		0.6	0.01	
Cameron Krutwig		-1.4	-0.01	
Clayton Custer		-6.7	-0.07	
Marques Townes		-8.9	-0.08	
Aundre Jackson		-10.7	-0.13	
Mean		-2.3	-0.022	
Std Dev		7.0	0.08	
Normalized				Comp
Ben Richardson		0.95	0.94	0.95
Lucas Williamson		0.73	0.76	0.74
Donte Ingram		0.66	0.64	0.65
Cameron Krutwig		0.55	0.54	0.55
Clayton Custer		0.26	0.26	0.26
Marques Townes		0.17	0.23	0.20
Aundre Jackson		0.11	0.08	0.10

B.1 Sensitivity Analyses

To examine these differences, a pair of sensitivity analyses were performed, focusing on the SUV statistics suspected of playing the primary role in these differences. First, not all missed shots are the same. Missed two-pointers and three-pointers receive an SUV of -1.0. However, missed lay-ups, unless self-assisted, receive an SUV of -1.6, i.e., there is more "negativity" assigned to missing a layup, supposedly the easiest of shots. Second, turnovers, including offensive fouls, are severely penalized, receiving an SUV of -2.0. Third, personal fouls resulting in shots for the opponent also receive more negative SUVs than missed shots (other than self-assisted layups): ranging from -1.2 to -2.1. Finally, missing one free throw (SUV = -0.7) offsets converting a pair (+0.6, or +0.3 each). These "negatives" are not necessarily reflected strongly in traditional statistics, unlike the SUV.

The sensitivity analyses addressed the first two categories: SUV = -1.6 for other than self-assisted missed layup and turnovers. For the first analysis, ALL missed layups were assumed to be self-assisted, reducing the negativity of the SUV from -1.6 to -1.0. The results are shown in Table 24. Note that Townes now trades ranks with Custer, with a significantly reduced negative SUV (now only -2.9 vs. previous -8.9). The effect on Williamson is minor. The second analysis further reduces the negativity of a turnover from -2.0 to -1.0 (assigning the remaining -1.0 to "Unassigned"), with the results in Table 25. While Custer and Townes switch positions again, note that Townes now acquires a very positive SUV of +8.1. Williamson's SUV also increases, although the net result since all players experience increases is a drop from second to fourth.

Interestingly, both sensitivity analyses preserve Richardson at the top and Jackson at the bottom. Therefore, while aggregation of the traditional statistics appears to suggest all but Ingram and Williamson of being fairly equally positive contributors (Composite normalized statistics in a fairly tight range from 0.50 to 0.65), the SUV Composites show Richardson as a stand-out top performer, with Williamson, Ingram and Krutwig next (range from 0.74 to 0.55), followed by Custer, Townes and Jackson. The differences in ranks are most likely the result of SUV assigning relatively significant "negatives" to detrimental plays, both offensively (missed layups and turnovers) and defensively (fouls that result in opponent free throws).

VII. Conclusion

Following the development and "Proof of Principle" for the SUV statistic for major league baseball, similar endeavors were made for both professional football and men's college basketball. Both followed the philosophy of assigning a value to each discrete entity that characterizes each sport: each at-bat for baseball; each play, comprised of field position, down and "yards to go" for a first down in football; each play in basketball that results in a shot (made or missed), foul, or turnover. As with baseball, the SUV statistics for football and basketball proved to be functional in measuring individual player performance via one overarching statistic. Results from the "Proof of Principle" exercises showed very good agreement with traditional statistics for football while uncovering some possibly unique insights that would lead to different conclusions in basketball from traditional statistics. For the latter, the SUV appears to incorporate the effect of "negative" outcomes more effectively than traditional basketball statistics.

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Table 24 And 25. SUV Sensitivity Analyses for (1) Assuming ALL Missed Layups to be Self-Assisted, and (2) Further Reducing the Negativity of a Turnover

Loyola Player	Cumu	SUV/Op	All missed layups now -1.0 instead of split of -1.6/+0.6
Ben Richardson	9.9	0.11	
Lucas Williamson	2.6	0.04	
Cameron Krutwig	2.2	0.02	
Donte Ingram	0.6	0.01	
Marques Townes	-2.9	-0.03	
Clayton Custer	-4.3	-0.05	
Aundre Jackson	-4.1	-0.05	
Mean	0.6	0.01	
Std Dev	5.0	0.06	
Normalized			Comp
Ben Richardson	0.97	0.96	0.97
Lucas Williamson	0.66	0.72	0.69
Cameron Krutwig	0.63	0.60	0.61
Donte Ingram	0.50	0.49	0.50
Marques Townes	0.24	0.27	0.26
Clayton Custer	0.166	0.167	0.167
Aundre Jackson	0.176	0.151	0.164

Loyola Player	Cumu	SUV/Op	All missed layups now -1.0 instead of split of -1.6/+0.6 AND turnovers/offensive fouls now split of -1.0/-1.0 instead of -2.0
Ben Richardson	15.9	0.17	
Cameron Krutwig	14.2	0.14	
Lucas Williamson	6.6	0.10	
Donte Ingram	8.6	0.09	
Clayton Custer	7.7	0.08	
Marques Townes	8.1	0.07	
Aundre Jackson	1.9	0.02	
Mean	9.0	0.10	
Std Dev	4.7	0.05	
Normalized			Comp
Ben Richardson	0.93	0.94	0.93
Cameron Krutwig	0.86	0.82	0.84
Donte Ingram	0.47	0.43	0.45
Lucas Williamson	0.31	0.54	0.43
Clayton Custer	0.39	0.37	0.38
Marques Townes	0.42	0.30	0.36
Aundre Jackson	0.07	0.06	0.06