An Analysis on Two Point Conversions

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Abstract

In 2015, the NFL instituted a rule change that pushed the distance of the extra-point back from the 2-yard line to the 15-yard line. Two-point attempts remained at the 2-yard line. Due to the increased difficulty in extra-points as a result of the rule-change, we anticipate that coaches are now more likely to attempt a two-point conversion than prior to the rule-change. A chi-squared test of significance for successes before and after the change, a difference-in-proportions test, and a fixed-effect logit model all align with our hypothesis: since the rule-change, teams are more inclined to try for a two-point conversion than they were before the rule change.

1. Introduction

In the National Football League (NFL), teams, after scoring a touchdown, have the choice of either kicking an extra-point (worth one point) or going for a two-point conversion (worth two-points). Prior to the start of the 2015 season, the NFL instituted a rule change, moving extra-points back from the 2-yard line to the 15-yard line, which turned a 20-yard kick into a 33-yard attempt. Two-point conversions were not affected by this rule change, and are still attempted from the 2-yard line. This change, and the ensuing decrease in likelihood of kickers making an extra-point try, begs the question of whether teams have changed their approach on these plays, attempting a two-point conversion more often than they used to. Are coaches more likely to elect to attempt a two-point conversion now than before the rule change?

Our research was motivated by the cloud of opinions surrounding the initial rule change. The NFL made this change in an attempt to increase the number of two-point conversions and make the game more exciting. At the time of the change, NFL sports writers and players were skeptical the rule change would have any effect on the game. Veteran NFL kicker Connor Barth believed the rule change would not be effective in changing NFL game play. He told the Denver Post, "Most guys hit 33 yarders in their sleep" (Tomlinson). He thought the NFL should instead narrow the goal posts to create a bigger challenge for kickers. Others were also dissatisfied with the new rule. The Indianapolis Colts, an NFL team, suggested to the NFL that they move the extra point back even further, making it 50 yards (Morris 2015). NFL coaches also questioned the intended effect of the rule change. In response to the new rule, head coach Gary Kubiak said he did not think it would change anything (Tomlinson). We decided to test against this skepticism and see if the rule changed the game, as the NFL anticipated it would.

We use three different methods for our statistical analysis. First, we calculate the expected value (in terms of points) for extra-point and two-point attempts both prior to and after the rule change in order to examine whether both the proportion of teams' extra-points and two-point attempts that were successful depend on the time period (whether or not the probability of success for each changed meaningfully after the rule change). We conduct a chi-squared test of independence to accomplish this, which helps us look at the question as to whether the success of attempts has any factor on a coach's intuition to go for a two-point attempt. Then, we run a difference in proportions test to measure the change in the proportions of two-point conversions before and after the rule-change. We also use a fixed-effect logit model to determine the factors that influence a coach's decision to go for a two-point conversion, specifically the impact of where the extra-point is kicked from (determined by whether the point-after attempt occurred before or after 2015).

Due to the recency of the rule-change, there is limited literature on the subject of our paper. An article from

FF Statistics challenges the idea that if the expected value of the two-point conversion is greater than the expectation of kicking an extra point, a team should attempt a two-point try every time. If teams should make their decision according to the expected value, coaches would be expected to go for the extra two points more often (Zingone). The author argues that the coefficient of variation (CV) is useful when determining which point-after opportunity is best when the expected values are similar; it is best to choose the CV with high expected value but low variance. This relates to coaching strategy in that coaches would want to pick the point-after option with a higher expectation and lower variance, not solely based on expected-value. The author's CV function points out that if the expected value for two-point attempts is marginally greater than that of extra point attempts, then the team should still go for the extra point (Zingone).

A different paper from *FiveThirtyEight* illustrates another common theory about the ideal time to go for a two-point conversion during a game (Morris 2017). Coaches traditionally would rather go for the safer extra-point than take the risk of going for two. The author claims that if a team is down by two, a two-point conversion try serves in their best interest, as it would improve their overall winning probability (Morris 2017). The best way to determine whether or not to go for two is by looking at point margins. If the change in win probability depends significantly on whether an extra-point or two-point conversion is attempted, then it is best to go for the strategy with a bigger marginal effect (Morris 2017). This provides guidelines for future analysis. However, we chose to ignore specific point margins in our paper because there will be no confounds caused by excluding this variable. This relies on our hypothesis that there is no significant change in the frequency of a scoring chance with any given point margin before or after the 2015 rule change.

Additionally, an article from *SB Nation* elaborates on the poor field-goal kicking in the 2019-2020 season. Currently, the amount of missed field goals and extra points are the lowest since 1995, while field goal percentage is also at its lowest since the 2003 season (Hardy et al.). Because of the increase in missed field goals, the author suggests that teams pursue fourth down conversions more often (Hardy et al.). The authors briefly mention coaching strategy, but look at the increased number of fourth-down attempts to show the decreased success of kickers instead of the proportion of two-point attempts. This paper is of limited relevance to our research because the authors look mainly at field-goal percentage, as opposed to extra-points. This paper, however, provides us with interesting information about how kicker ability may have changed, but it does not quite address our research question given that we are looking at whether or not coaches elect to go for more two-point conversions. We intend to focus more on how coaching strategies for two-point conversions have changed since the extra-point was moved back to the 33-yard line.

The paper continues as such: section 2 discusses the research design (including what data we used and the methodology for analysis), section 3 gives the results, section 4 talks about the limitations and confounds of

our research, and section 5 concludes the paper and touches on further research.

2. Research Design

2.1 Data

We collected all of our data from profootballreference.com. Pro Football Reference's Game Play Finder allowed us to filter out every point-after attempt of the regular season from 2010 to 2019, comprising roughly five seasons worth of data both before and after the rule change. In total we have 12186 point-after attempts to analyze. Each point-after attempt includes the game-date, matchup, current score, quarter, and outcome (success or failure). The first 50 point-after attempts for both time periods–from 2010 to 2014 and from the 2015 season to October 30, 2019–are included in **Appendix A** and **Appendix B**.

Methodology

We conduct three tests of analysis for this paper.

2.2 Chi-Squared Test

The first test we run is a chi-squared test of independence for both two-point conversions and extra-point kicks. We want to confirm the intuition that, upon the rule change, the probability of converting an extra-point kick decreases meaningfully (since the kick is further back) and the probability of converting a two-point conversion does not change significantly. Below our are null and alternative hypotheses:

H_0 : *The probability of success of two-point attempts / extra point kicks before the rule-change is equal to the probability of success of two-point attempts / extra point kicks after the rule-change.*

H_a : *The probability of success of two-point attempts / extra point kicks before the rule-change is different than the probability of success of two-point attempts / extra point kicks after the rule-change.*

For both extra-point kicks and two-point conversions, we construct a table of successes and failures (**Table 1** and **Table 2**) and run Pearson's Chi-squared test with Yates' continuity correction on the data. In this instance, a large p-value indicates a low chance of the probability of success changing (meaning we fail to reject our null) whereas a small p-value would indicate a high chance of the probability of success having changed (meaning we have statistical evidence to reject our null hypothesis).

Table 1:

	Kicks Made	Kicks Missed
Before Rule Change	6106	42
After Rule Change	4967	306

Table 2:

	Two Points Made	Two Points Missed
Before Rule Change	139	144
After Rule Change	221	231

2.3 Difference in Proportions Test

We run a differences in proportions test to determine if there is a significant overall difference in the proportions of two-point conversions attempted prior to and after the rule-change. Our hypothesis used:

H_0 : *The proportions of two-point attempts before the rule-change is equal to the proportions of two-point attempts after the rule-change.*

H_a : *The proportions of two-point attempts before the rule-change is less than the proportions of two-point attempts after the rule-change.*

A small p-value implies that we have statistical evidence that the proportions increased after the NFL installed the rule-change, thus rejecting our null hypothesis.

2.4 Fixed-Effect Logit Model

Since not all point-after attempts are the same, we also use a fixed-effect logit model to identify the effect of the predictor variable, in this case the era (pre-rule change or post-rule change), on the probability of a coach electing to go for a two-point conversion. Our binary dependent variable is whether or not the coach chooses to go for a two-point try. This variable takes a value of 0 if the team kicks the extra-point or 1 if the coach elects to try a two-point conversion. The independent variable for each point-after attempt is the distance of the extra-point, which is determined by the era that the attempt occurred in. We hold fixed quarter of the game, the team attempting the point-after, and whether or not the game was a blowout or not. We define a blowout as a difference in score greater than two touchdowns (or 14 points). We hold these variables fixed in order to control for quarter, team, and blowout-effect. This allows us to determine the significance of moving the extra-point back on a coach's decision to attempt a two-point conversion while grouping by these three independent variables. We will also be able to look at the teams that have the largest and smallest fixed

effects on the probability of a coach deciding to attempt a two-point conversion. We utilize a fixed-effect model to reduce the team, quarter, and blowout-effect on the dependent variable.

Our logit model is as follows:

P(Point-After Attempt = 1) =

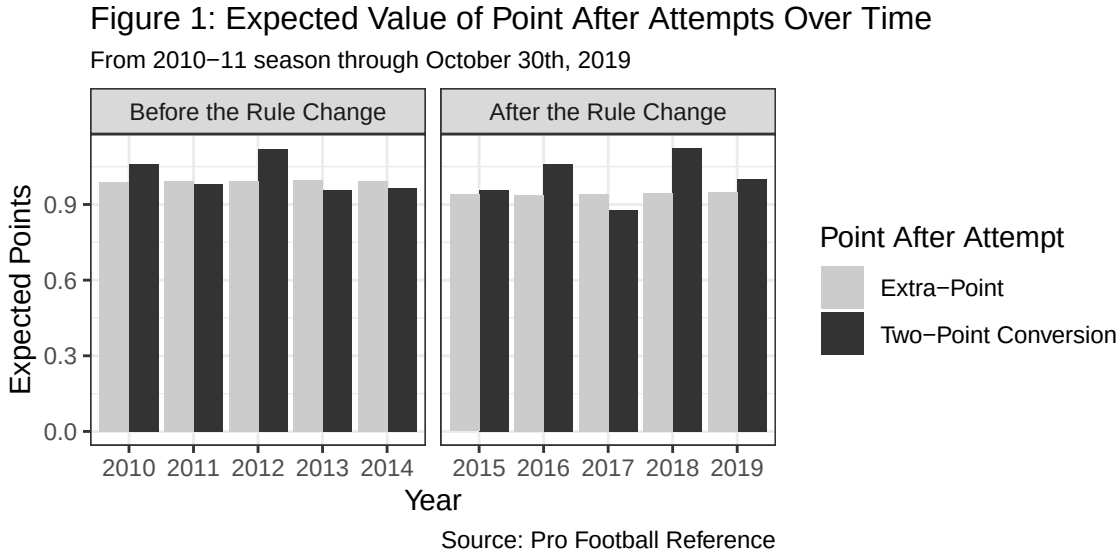
$$\frac{e^{\beta_0+\beta_1 x_{RuleChange}}}{1+e^{\beta_0+\beta_1 x_{RuleChange}}}$$

$x_{ruleChange}$ is the independent variable representing the era of each point-after attempt. This binary variable takes 0 when the point-after attempt occurred prior to the rule change or 1 if it occurs after the change. β_0 is the sum of the fixed effects for each individual instance (depending on team or quarter or blowout status), and β_1 is the beta-coefficient for $x_{RuleChange}$, which gives the change in the log-odds of a coach attempting a two-point conversion for a one unit increase in the predictor variable.

3 Results

3.1 Chi-Squared

Before the rule change, the expected values of extra-point attempts and two-point conversion attempts were 0.9932 and 0.9823, respectively. After the rule change, the expected value of extra-point attempts decreases to 0.942 while the expected value of two-point attempts remains about the same at 0.9779. **Figure 1** shows the expected point value of each type of point-after attempt for each season.



This confirms our expectations: the expected-value for point-after attempts declines once the NFL installed

the rule-change, whereas while the two-point conversion's expected value fluctuates overall from year-to-year, it remains relatively unchanged overall. We conduct two chi-squared tests of independence to confirm whether the changes in probability are statistically significant or, instead, simply the result of random variation in the data. The results are shown in **Table 3**.

Table 3:

	Chi-Squared Value	Degrees of Freedom	P-Value
Extra-Points	250.1483	1	$<$ 2.22e-16
Two-Point Conversions	0	1	1

The chi-squared test of independence for two point conversions gives a high p-value, which leads us to fail to reject the null hypothesis and conclude that the probability of success for two point conversions did not change significantly after the rule change. For the chi-squared test of independence for extra point kicks, our p-value is approximately 0 ($<$ 2.22e-16), which, using a level of significance of 0.05, gives us statistical evidence to reject the null hypothesis, concluding that the probability of success for extra-point kicks changed significantly after the rule change. These results are a useful foundation for the rest of our study, as we have found that there is a substantial rationale for coaches to change their behavior on point-after attempts – not only did the probability of making extra-point kicks decrease significantly, but the expected value of an extra point try also changed from more than that of two-point conversions before the rule change to less than that of two-point conversions after the rule change.

3.2 Difference in Proportions Test

We expect the proportion of two-point attempts to rise after the rule-change. **Figure 2** conveys this expectation, showing the proportion of two-point attempts for each season before and after the rule change.

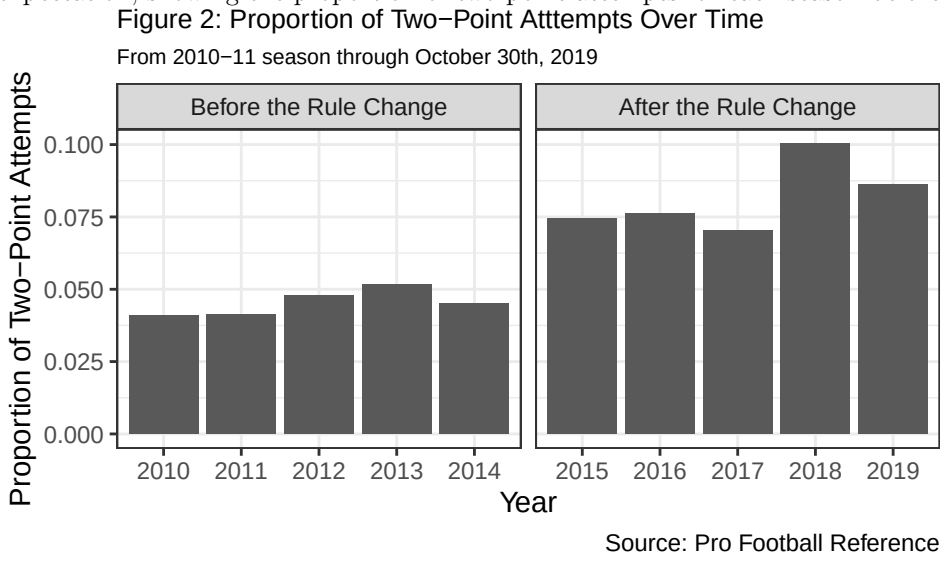


Table 4 gives the results of the difference in proportions test, with degrees of freedom of 1.

Table 4:

	Proportion Before 2015	Proportion After 2015	Test-Statistic	Degrees of Freedom	P-Value
1	0.045	0.081	64.8122	1	4.1194e-16

The observed proportions rose from 0.045 before the rule-change to 0.081 The p-value for our test is approximately 0. Using a level-of-significance of 0.05, we reject the null hypothesis (that the proportion of two-point attempts before the rule-change equals the proportion of attempts after 2015). Thus, we have strong statistical evidence that there are less proportions of two-point attempts before the rule-change then after the change. We can cross-check this result with the beta coefficient on our logit model to ensure that the sign on our logit model is correct.

3.3 Logit Model

Table 5 below gives the beta-coefficients for our fixed-effect logit model.

Table 5:

	Beta-Coefficients	P-Value
Intercept	-5.4403	$<$ 2.22e-16
Era	0.6333	3.0358e-15

The change in era has a positive β_1 of 0.6333. To determine the change in probability of a coach going for a two-point conversion from before the rule-change to after, we find the odds of this change (originally expressed in log-odds), which are equal to e^{β_1}. The value of $\frac{odds}{1+odds}$ gives this probability, which equals 0.6532 This means that, according to our model, coaches have a 0.6532 higher probability of attempting a two-point conversion attempt after the rule-change (between 2015 and October 30th, 2019) then before. Thus, the logit model confirms what we expected after our difference in proportions test. Using a level of significance of 0.05, we find that the era's impact is statistically significant, as the p-value for β_1 is approximately 0.

One other observation from our logit model is each team's effect on the overall probability of a coach going for two. **Appendix C** gives the beta-coefficients from the fixed-effect logit model and the level of significance (the p-value) for 31 teams in the NFL. The San Francisco 49ers' beta-coefficient is set as the baseline value of 0, thus all values are relative to the 49ers. The Tampa Bay Buccaneers, Philadelphia Eagles, Pittsburgh Steelers, Chicago Bears, and Jacksonville Jaguars have the five largest impacts from the data on the logit-model probability. These five organizations are more inclined than others to attempt a two-point conversion, independent of era, quarter, and score. **Appendix D** gives the beta-coefficients for quarter and score.

4. Problems

Our model is limited because we do not have a comparison group. We assume the NFL is roughly the same before and after the rule change. However, other underlying factors in the NFL may have changed from 2010 to 2019 that affect a coach's decision to go for two points. Without a comparison group, one potential source of omitted variable bias is coaching philosophy. NFL programs have become more receptive of data analytics in recent years, thus coaching philosophy could have changed between the two time periods. Therefore, there may be more coaches who, after any given touchdown, go for two points in 2019 more than in 2010 because they now rely on statisticians rather than their "gut feelings" or other traditional coaching philosophies. In other words, if this were a significant effect there would be more two point attempts in more recent years regardless of a rule change. This would mean that our estimate of β_1 in our logit model is greater than the true value. Because of this variable, we may be overestimating the effect of the rule change on a coach's decision to go for two points.

One confound in our data is the effect of penalties on a coach's decision making. Our dataset does not indicate whether or not a penalty had been called before the play. A penalty on the offensive team will push the attempt back anywhere from 5-15 yards and a penalty on the defensive team will move the attempt forward anywhere from 5 yards to half the distance to the goal. We believe a coach will almost certainly kick an extra point instead of going for two points after a penalty pushes them 5-15 yards back. This complicates our analysis because, according to Pro Football Reference, penalties per game have steadily increased between 2010 and 2018. Since there are more penalties per game after the rule change than before, there may be more extra point attempts after the rule change as a result of a more penalties. This would decrease the β_1 coefficient in our logit model. Therefore, we may be underestimating the effect of the rule change on a coach's decision to go for two. Since there are more penalties per game after the rule change than before, there may be more extra point attempts after the rule change as a result of a more penalties. This would decrease the β_1 coefficient in our logit model. Therefore, we may be underestimating the effect of the rule change on a coach's decision to go for two.

One limitation with our design is that we are unable to differentiate between situational and non-situational two point attempts: the data lacks the exact time that each score occurred for every point and information on the score prior to the point-after attempt. In certain scenarios, which we characterize as situational two point attempts, coaches automatically go for two. One example of a situational attempt would be if a team scores a touchdown and is down by two with under five minutes left in the game, in which case they will elect to go for a two-point conversion nearly every time. Therefore, the rule change would not affect their

decision-making in these situations. Since we are unable to differentiate the situational and non-situational two-point attempts, we include all attempts in our statistical tests. However, we assume that there is not a significant change in the proportion of situational attempts before and after the rule change. Based on this assumption, situational attempts do not affect our estimate of β_1 (the beta-coefficient of era). The likelihood of going for a two point attempt would be higher on said attempts both before and after the rule change; thus the change between the two time periods would remain the same. Our limitation is that our design relies on this assumption, because we do not have access to exact time data or point margins.

5. Conclusion

The results of this paper proved as expected: after the NFL moved the extra-point back 12 yards, teams are more inclined to attempt a two-point conversion than kick an extra-point. Along with re-running our analysis with situational attempts factored out, or with penalties factored in, further research could be done to strengthen our approach. One could use the NCAA football league as a comparison group to improve our logit estimate. The NCAA football league has not changed their extra point over our time period and therefore they could be used to compare for any underlying trends that may have emerged in football around the time of our era change. In addition, one could try to capture the effect of sports analytics on coaching philosophy. They could look at the number of data analysts and statisticians hired in the league each year and control for that in our logit model. This approach would help address the potential omitted variable bias inherent in our analysis through our use of a regression model, and would thus make our estimate more accurate.

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Appendix A

Point-After Attempts Before Rule-Change (2010-2014)

Date	Tm	Opp	Quarter	Time	Down	Yards	Location	Score	Detail
2010-11-25	Patriots	Lions	4	3:16	NA	NA	NA	24-45	Shayne Graham kicks extra point good. Penalty on Ndamukong Suh: Unnecessary Roughness, 15 yards, Penalty on DeAndre Levy: Personal Foul (Declined)
2010-12-26	Patriots	Bills	2		NA	NA	NA	3-24	Shayne Graham kicks extra point good. Penalty on Drayton Florence: Defensive Offside, 5 yards
2012-09-23	Patriots	Ravens	2	0:07	NA	NA	NA	14-20	Stephen Gostkowski kicks extra point good. Penalty on Courtney Upshaw: Personal Foul, 15 yards
2010-09-12	Patriots	Bengals	1		NA	NA	NA	7-0	Stephen Gostkowski kicks extra point good
2010-09-12	Patriots	Bengals	2		NA	NA	NA	17-0	Stephen Gostkowski kicks extra point good
2010-09-12	Patriots	Bengals	2		NA	NA	NA	24-0	Stephen Gostkowski kicks extra point good
2010-09-12	Patriots	Bengals	3		NA	NA	NA	31-3	Stephen Gostkowski kicks extra point good
2010-09-12	Patriots	Bengals	4		NA	NA	NA	38-17	Stephen Gostkowski kicks extra point good
2010-09-19	Patriots	Jets	2		NA	NA	NA	0-7	Stephen Gostkowski kicks extra point good
2010-09-19	Patriots	Jets	2		NA	NA	NA	7-14	Stephen Gostkowski kicks extra point good
2010-09-26	Patriots	Bills	1		NA	NA	NA	7-3	Stephen Gostkowski kicks extra point good
2010-09-26	Patriots	Bills	2		NA	NA	NA	14-13	Stephen Gostkowski kicks extra point good
2010-09-26	Patriots	Bills	3		NA	NA	NA	24-16	Stephen Gostkowski kicks extra point good
2010-09-26	Patriots	Bills	3		NA	NA	NA	31-23	Stephen Gostkowski kicks extra point good
2010-09-26	Patriots	Bills	4		NA	NA	NA	38-23	Stephen Gostkowski kicks extra point good
2010-10-04	Patriots	Dolphins	3		NA	NA	NA	7-13	Stephen Gostkowski kicks extra point good
2010-10-04	Patriots	Dolphins	3		NA	NA	NA	7-20	Stephen Gostkowski kicks extra point good
2010-10-04	Patriots	Dolphins	3		NA	NA	NA	14-27	Stephen Gostkowski kicks extra point good
2010-10-04	Patriots	Dolphins	4		NA	NA	NA	14-34	Stephen Gostkowski kicks extra point good
2010-10-04	Patriots	Dolphins	4		NA	NA	NA	14-41	Stephen Gostkowski kicks extra point good
2010-10-17	Patriots	Ravens	1		NA	NA	NA	7-3	Stephen Gostkowski kicks extra point good
2010-10-17	Patriots	Ravens	4		NA	NA	NA	17-20	Stephen Gostkowski kicks extra point good
2010-10-24	Patriots	Chargers	1		NA	NA	NA	3-7	Stephen Gostkowski kicks extra point good
2010-10-24	Patriots	Chargers	3		NA	NA	NA	3-20	Stephen Gostkowski kicks extra point good
2010-10-31	Patriots	Vikings	2		NA	NA	NA	7-7	Stephen Gostkowski kicks extra point good
2010-10-31	Patriots	Vikings	3		NA	NA	NA	14-10	Stephen Gostkowski kicks extra point good
2010-10-31	Patriots	Vikings	3		NA	NA	NA	21-10	Stephen Gostkowski kicks extra point good
2010-10-31	Patriots	Vikings	4		NA	NA	NA	28-18	Stephen Gostkowski kicks extra point good
2010-11-07	Patriots	Browns	2		NA	NA	NA	10-7	Stephen Gostkowski kicks extra point good
2010-11-07	Patriots	Browns	4		NA	NA	NA	27-14	Wes Welker kicks extra point good
2010-11-14	Patriots	Steelers	1	9:54	NA	NA	NA	0-7	Shayne Graham kicks extra point good
2010-11-14	Patriots	Steelers	3	9:54	NA	NA	NA	3-17	Shayne Graham kicks extra point good
2010-11-14	Patriots	Steelers	3	0:25	NA	NA	NA	3-23	Shayne Graham kicks extra point no good
2010-11-14	Patriots	Steelers	4	8:32	NA	NA	NA	10-29	Two Point Attempt: Tom Brady pass incomplete intended for Brandon Tate, conversion fails
2010-11-14	Patriots	Steelers	4	4:31	NA	NA	NA	18-36	Shayne Graham kicks extra point good
2010-11-21	Patriots	Colts	1	8:07	NA	NA	NA	7-0	Shayne Graham kicks extra point good
2010-11-21	Patriots	Colts	2	13:20	NA	NA	NA	14-0	Shayne Graham kicks extra point good
2010-11-21	Patriots	Colts	2	3:38	NA	NA	NA	21-7	Shayne Graham kicks extra point good
2010-11-21	Patriots	Colts	3	1:20	NA	NA	NA	28-14	Shayne Graham kicks extra point good
2010-11-25	Patriots	Lions	2	0:53	NA	NA	NA	14-10	Shayne Graham kicks extra point good
2010-11-25	Patriots	Lions	3	11:06	NA	NA	NA	17-17	Shayne Graham kicks extra point good
2010-11-25	Patriots	Lions	3	5:27	NA	NA	NA	24-24	Shayne Graham kicks extra point good
2010-11-25	Patriots	Lions	4	13:51	NA	NA	NA	24-31	Shayne Graham kicks extra point good
2010-11-25	Patriots	Lions	4	6:47	NA	NA	NA	24-38	Shayne Graham kicks extra point good
2010-12-06	Patriots	Jets	1		NA	NA	NA	10-0	Shayne Graham kicks extra point good
2010-12-06	Patriots	Jets	1		NA	NA	NA	17-0	Shayne Graham kicks extra point good
2010-12-06	Patriots	Jets	2		NA	NA	NA	24-3	Shayne Graham kicks extra point good
2010-12-06	Patriots	Jets	3		NA	NA	NA	31-3	Shayne Graham kicks extra point good
2010-12-06	Patriots	Jets	4		NA	NA	NA	38-3	Shayne Graham kicks extra point good
2010-12-06	Patriots	Jets	4		NA	NA	NA	45-3	Shayne Graham kicks extra point good

Appendix B

Point-After Attempts After Rule-Change (2015-2019)

Date	Tm	Opp	Quarter	Time	Down	Yards	Location	Score	Detail
2015-09-10	Patriots	Steelers	4	9:24	NA	0	PIT 1	28-14	Stephen Gostkowski kicks extra point good. Penalty on Steve McLendon: Defensive Holding, 5 yards
2015-09-20	Patriots	Bills	1	1:04	NA	0	BUF 6	7-14	Stephen Gostkowski kicks extra point good. Penalty on Aaron Williams: Taunting, 15 yards
2017-01-01	Patriots	Dolphins	4	5:33	NA	0	MIA 2	14-35	Two Point Attempt: Tom Brady pass complete to Julian Edelman, conversion succeeds. Penalty on Tony Lippett: Face Mask (15 Yards), 15 yards
2018-09-09	Patriots	Texans	1	11:50	NA	0	HTX 15	7-0	Stephen Gostkowski kicks extra point good
2018-09-09	Patriots	Texans	2	12:38	NA	0	HTX 15	14-3	Stephen Gostkowski kicks extra point good
2018-09-09	Patriots	Texans	2	0:14	NA	0	HTX 15	21-6	Stephen Gostkowski kicks extra point good
2018-09-16	Patriots	Jaguars	3	1:42	NA	0	JAX 15	24-10	Stephen Gostkowski kicks extra point good. Penalty on Malik Jackson: Unnecessary Roughness, 15 yards
2018-09-16	Patriots	Jaguars	4	3:40	NA	0	JAX 15	31-20	Stephen Gostkowski kicks extra point good. Penalty on Calais Campbell: Leverage, 15 yards
2018-09-23	Patriots	Lions	3	10:03	NA	0	DET 15	13-10	Stephen Gostkowski kicks extra point good
2018-09-30	Patriots	Dolphins	2	12:01	NA	0	MIA 15	10-0	Stephen Gostkowski kicks extra point good
2018-09-30	Patriots	Dolphins	2	7:29	NA	0	MIA 15	17-0	Stephen Gostkowski kicks extra point good
2018-09-30	Patriots	Dolphins	2	0:18	NA	0	MIA 15	24-0	Stephen Gostkowski kicks extra point good
2018-09-30	Patriots	Dolphins	3	6:49	NA	0	MIA 15	31-0	Stephen Gostkowski kicks extra point good
2018-09-30	Patriots	Dolphins	4	13:43	NA	0	MIA 15	38-0	Stephen Gostkowski kicks extra point good
2018-10-04	Patriots	Colts	1	8:58	NA	0	CLT 15	7-0	Stephen Gostkowski kicks extra point good
2018-10-04	Patriots	Colts	2	12:14	NA	0	CLT 15	14-0	Stephen Gostkowski kicks extra point good
2018-10-04	Patriots	Colts	2	1:34	NA	0	CLT 15	21-3	Stephen Gostkowski kicks extra point good
2018-10-04	Patriots	Colts	4	9:19	NA	0	CLT 15	31-17	Stephen Gostkowski kicks extra point good
2018-10-04	Patriots	Colts	4	7:08	NA	0	CLT 15	38-17	Stephen Gostkowski kicks extra point good
2018-10-14	Patriots	Chiefs	1	4:57	NA	0	KAN 15	10-3	Stephen Gostkowski kicks extra point good
2018-10-14	Patriots	Chiefs	2	12:52	NA	0	KAN 15	17-6	Stephen Gostkowski kicks extra point good
2018-10-14	Patriots	Chiefs	2	1:57	NA	0	KAN 15	24-9	Stephen Gostkowski kicks extra point good
2018-10-14	Patriots	Chiefs	4	5:25	NA	0	KAN 15	37-33	Stephen Gostkowski kicks extra point good
2018-10-21	Patriots	Bears	1	11:00	NA	0	CHI 15	0-7	Stephen Gostkowski kicks extra point good
2018-10-21	Patriots	Bears	2	10:48	NA	0	CHI 15	17-14	Stephen Gostkowski kicks extra point good
2018-10-21	Patriots	Bears	2	3:58	NA	0	CHI 15	17-21	Stephen Gostkowski kicks extra point good
2018-10-21	Patriots	Bears	4	8:40	NA	0	CHI 15	24-38	Stephen Gostkowski kicks extra point good
2018-10-29	Patriots	Bills	4	9:58	NA	0	BUF 2	6-18	Two Point Attempt: Tom Brady pass incomplete intended for Cordarrelle Patterson, conversion fails. Interception by Julian Stanford
2018-11-04	Patriots	Packers	1	11:40	NA	0	GNB 15	7-0	Stephen Gostkowski kicks extra point good
2018-11-04	Patriots	Packers	2	1:57	NA	0	GNB 15	17-10	Stephen Gostkowski kicks extra point good
2018-11-04	Patriots	Packers	4	10:06	NA	0	GNB 15	24-17	Stephen Gostkowski kicks extra point good
2018-11-04	Patriots	Packers	4	7:20	NA	0	GNB 15	31-17	Stephen Gostkowski kicks extra point good
2018-11-11	Patriots	Titans	2	12:49	NA	0	OTI 15	17-10	Stephen Gostkowski kicks extra point good
2018-11-25	Patriots	Jets	1	1:11	NA	0	NYJ 15	7-7	Stephen Gostkowski kicks extra point good
2018-11-25	Patriots	Jets	3	1:52	NA	0	NYJ 15	13-20	Stephen Gostkowski kicks extra point good
2018-11-25	Patriots	Jets	4	8:54	NA	0	NYJ 15	13-27	Stephen Gostkowski kicks extra point good
2018-12-02	Patriots	Vikings	1	9:33	NA	0	MIN 15	7-0	Stephen Gostkowski kicks extra point good
2018-12-02	Patriots	Vikings	3	0:35	NA	0	MIN 15	17-10	Stephen Gostkowski kicks extra point good
2018-12-02	Patriots	Vikings	4	10:54	NA	0	MIN 15	24-10	Stephen Gostkowski kicks extra point good
2018-12-09	Patriots	Dolphins	1	8:13	NA	0	MIA 15	0-6	Stephen Gostkowski kicks extra point no good hit right upright
2018-12-09	Patriots	Dolphins	2	14:14	NA	0	MIA 15	7-13	Stephen Gostkowski kicks extra point good
2018-12-09	Patriots	Dolphins	2	10:32	NA	0	MIA 15	14-20	Stephen Gostkowski kicks extra point good
2018-12-09	Patriots	Dolphins	2	3:49	NA	0	MIA 15	21-27	Stephen Gostkowski kicks extra point good
2018-12-16	Patriots	Steelers	1	6:48	NA	0	PIT 20	7-7	Stephen Gostkowski kicks extra point good
2018-12-23	Patriots	Bills	1	7:32	NA	0	BUF 15	7-0	Stephen Gostkowski kicks extra point good
2018-12-23	Patriots	Bills	2	9:59	NA	0	BUF 15	14-0	Stephen Gostkowski kicks extra point good
2018-12-23	Patriots	Bills	3	5:05	NA	0	BUF 15	21-6	Stephen Gostkowski kicks extra point good
2018-12-30	Patriots	Jets	1	5:16	NA	0	NYJ 15	7-0	Stephen Gostkowski kicks extra point good
2018-12-30	Patriots	Jets	2	12:53	NA	0	NYJ 15	14-3	Stephen Gostkowski kicks extra point good
2018-12-30	Patriots	Jets	2	11:03	NA	0	NYJ 15	21-3	Stephen Gostkowski kicks extra point good

Appendix C

Team Beta-Coefficients

Team	Beta-Coefficient	P-Value
Patriots	-0.3124848	0.044469
Bills	0.3972763	0.51631
Jets	0.0735489	0.25642
Dolphins	0.0624831	0.50943
Ravens	0.5504576	0.025132
Steelers	0.8722671	0.0047673
Browns	0.7699118	0.1126
Bengals	-0.2576568	0.92321
Colts	0.2845690	0.67796
Texans	-0.3036621	0.41562
Jaguars	0.8718347	0.87579
Titans	-0.0199067	0.86931
Chiefs	-0.1591617	0.0066742
Raiders	0.1887912	0.18993
Chargers	-0.0364221	0.38713
Broncos	0.2299919	0.0092003
Cowboys	-0.0568677	0.84856
Eagles	0.8786086	0.070664
Giants	0.3025601	0.30095
Redskins	0.4771345	0.56244
Packers	0.3535572	0.41256
Vikings	0.4338690	0.60176
Lions	0.6010771	0.12645
Bears	0.6837916	0.10884
Saints	0.0165274	0.17054
Panthers	0.2092452	0.96233
Buccaneers	0.9181653	0.75425
Falcons	0.4438200	0.0071463
Seahawks	0.1107917	0.44427
Rams	0.5403081	0.9581
Cardinals	0.5449228	0.21839

Appendix D

Quarter and Score Beta-Coefficients

Variable	Beta-Coefficient	P-Value
2nd Quarter	0.8704632	0.00054208
3rd Quarter	1.8590295	7.0781e-15
4th Quarter	3.1918539	7.0781e-15
Score	-0.4703073	1.9704e-06