

Rethinking 2-Point Conversions and 4th & Short

Patrick Walsh
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About Me

- Background in Business Administration (Business Analytics & Finance)
- **Work Experience:** Kearney, Routinely (NYC rental workout clothing startup), Binghamton University Student Association
- **Leadership Experience:** HS Football Captain, VP Pledge Education for Delta Sigma Pi
- Life-long competitor and sports fan
 - Grew up playing football, basketball, and gaming (interest in Esports), working towards first marathon



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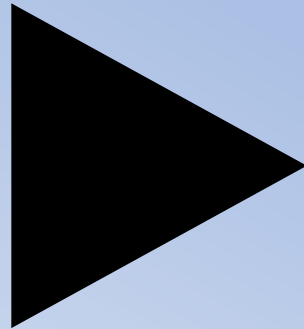
Presentation Overview

- This presentation was designed to further explore NFL Data while honing my skills in SQL, Tableau, and Excel
- The findings are useful for NFL coaches, sports journalists, fans, and others looking to research NFL data
- The data was compiled by a group of Carnegie Mellon researchers and is available on Kaggle¹

Experimental Procedure

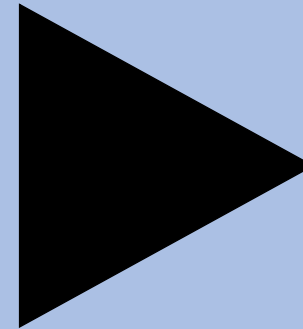
Questions

- Are teams becoming more aggressive on 4th and short & in 2-point conversion situations?
- What are the play call tendencies in these situations? Has it changed over time? Does the situation in the game influence it?
- Is there a more successful play type in these short yardage situations?



Analysis

- Time series analysis of attempts by season and as a % of total opportunities (2-point attempts/touchdowns, & 4th down attempts/total 4th and short opportunities)
- High level breakdown of pass/run frequency and conversion in each situation, followed by deep dive factoring game-state pressure¹ and field position²



Findings

- 2018 2-point conversion attempts are 2.28x that of the 2009-2014 average, and 1.49x the 2015-2017 average
- 4th and short was attempted more often in 2018 despite fewer opportunities
- Passes are heavily favored (75%) in 2-point conversion and 4th and 2 situations, runs in 4th and 1 situations (73%)
- Increased pressure leads to higher likelihood of passing
- Runs are more effective on all play calls, yet are called far less often than pass plays on 4th and 2 and 2-point conversions

1- Appendix Exhibit 2 (Pressure Scale)

2- Appendix Exhibit 11 (4th and 1 by Pressure and Field Position Over Time)

Definitions

Play Type/Play Call - Run or Pass

Play Type Frequency – Number of times a play was called out of all attempts in a given situation (stated as a rate or % – i.e. pass plays had a frequency of .7 or 70%)

Total Opportunities/Instances – Total number of times given situation occurs (1000 would indicate there were 1000 plays in which the offense faced a 4th and 1), or the sum of attempts and non-attempts

Conversion Rate – The number of successful attempts/total attempts

Growth Rate/% Growth – $(\text{Current Period} - \text{Previous Period}) / \text{Previous Period}$

Pressure¹ – An assigned value (low, medium, high) accounting for the score differential and quarter in the game (A team trailing by 10 in the 2nd quarter would be in a **medium pressure situation**, whereas a team trailing by 5 in the 4th quarter would be in a **high pressure situation**)

Opp – Opponent's side of the field (within 50 yards of the endzone)

Scramble² – A called pass play in which the quarterback decides to run the ball after the play breaks down

PAT – Point after touchdown

1- Appendix Exhibit 2 (Pressure Scale)

2- Appendix Exhibit 13 (QB Runs on 2-point Conversions)

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Overview

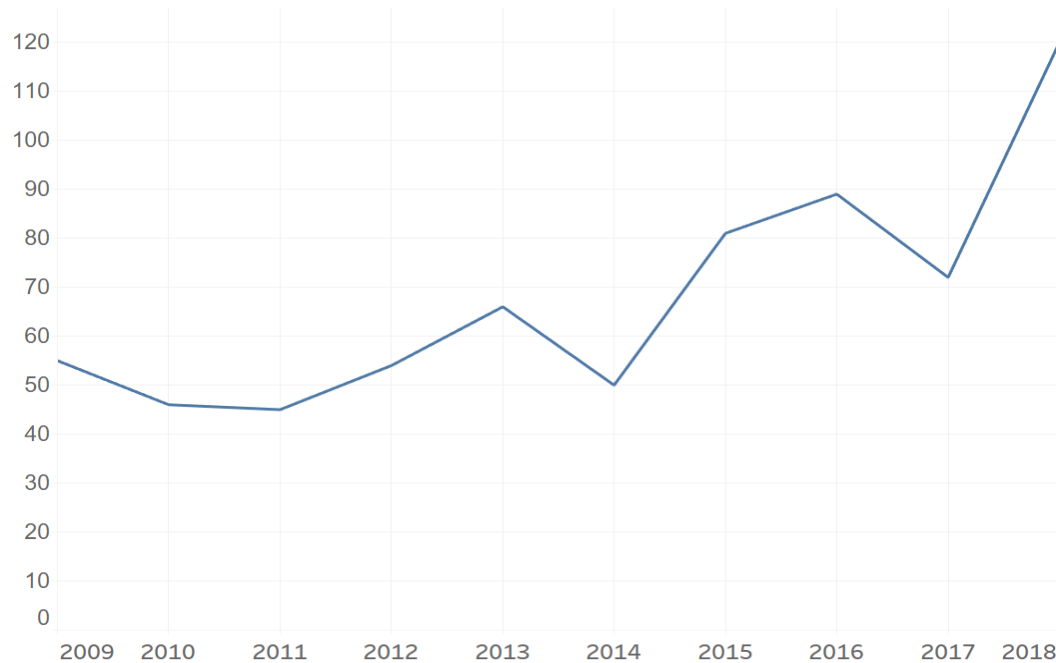
2-Point Attempts

4th Down Attempts

Takeaways

The number of 2-point conversion attempts is rapidly increasing, and 120 attempts in 2018 is double that of the average attempts prior to 2015

2-Point Attempts by Season



2-Point Attempts – Ratio Analysis

2-Point Attempts	2009-2014 (Average)	2015-2017 (Average)	2018	2018 % Growth
# of Attempts	52.67	80.67	120.00	48.76%
Touchdowns	1281.33	1275.67	1279.00	0.26%
Attempts as a % of Touchdowns	4.11%	6.32%	9.38%	48.37%
Attempts per Team	1.65	2.52	3.75	48.76%

Excludes touchdowns scored in overtime as these conclude the game and no PAT is attempted

Changes in rules (moving back the PAT kick in 2015) was a catalyst for the initial surge in attempts, and teams have seemed willing to further experiment in the subsequent years

Data shows surge in attempts is not tied to an increase in the # of opportunities (touchdowns), rather more willingness to go for 2

2-Point conversions attempts have skyrocketed, and on average, teams will face a total of 4.2 more attempts per 16 game regular season than in the years prior to 2015 (2.1 offensively, 2.1 defensively)

There was growth in 2-point attempts throughout all situations in a game, though low and medium pressure¹ situations saw the highest % change in 2018!

2-Point Attempts Over Time – By Pressure

2-Point Attempts	2009-2014 (Average)			2015-2017 (Average)			2018 Values			2018 % Growth (From 2015-2017)		
	L	M	H	L	M	H	L	M	H	L	M	H
Pressure												
# of Attempts	2.67	6.67	43.33	7.00	17.33	56.33	17.00	28.00	75.00	142.86%	61.54%	33.14%
Touchdowns	540.00	407.33	334.00	512.00	416.33	347.33	556.00	379.00	344.00	8.59%	-8.97%	-0.96%
Attempts Per TD by Pressure	0.49%	1.68%	13.04%	1.37%	4.16%	16.22%	3.06%	7.39%	21.80%	123.64%	77.45%	34.43%
Total Attempts Per TD	4.11%			6.32%			9.38%			48.76%		
% Growth from Previous Period				53.84%			48.37%					

L = Low Pressure

M = Medium Pressure

H = High Pressure

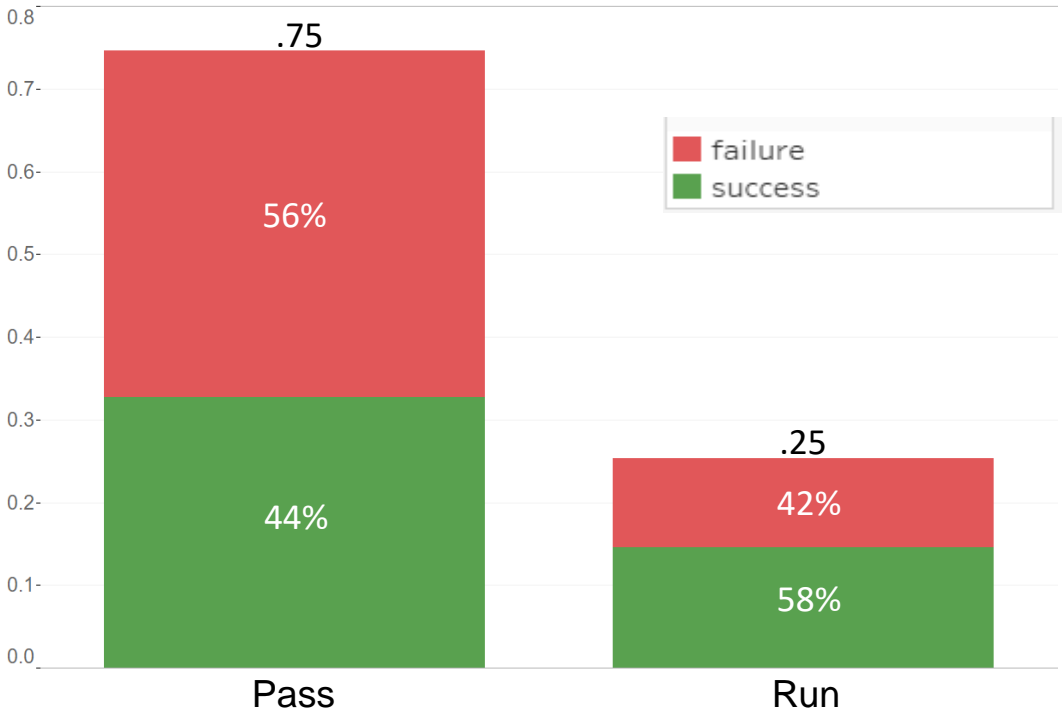
The dramatic uptick in attempts during **low and medium pressure situations** implies the growth is primarily driven by **more aggressive play-calling early in games** (going for it when not necessary to catch-up or build a lead) and not a product of the “need” to go for 2-point conversions in close games

1- Appendix Exhibit 2 (Pressure Scale)

Appendix Exhibit 4 (2-Point Conversion Ratios)

There is an overwhelming tendency to throw the ball when attempting a 2-point conversion despite a glaring difference in the conversion rate of each play type

2-Point Play Call Frequency and Conversion



2-Point Attempts – Team Breakdown

Teams	Pass - Fail	Pass - Success	Total Passes	Run - Fail	Run - Success	Total Runs	Total Attempts	% Passes	% Runs	Pass Success (%)	Run Success (%)	Total Success
CHI	5	15	20	2	6	8	28	71%	29%	75%	75%	75%
LAC	5	8	13	0	2	2	15	87%	13%	62%	100%	67%
PHI	7	7	14	2	10	12	26	54%	46%	50%	83%	65%
LA	3	9	12	5	5	10	22	55%	45%	75%	50%	64%
NYG	6	2	8	1	10	11	19	42%	58%	25%	91%	63%
PIT	13	19	32	1	3	4	36	89%	11%	59%	75%	61%
MIN	6	7	13	2	5	7	20	65%	35%	54%	71%	60%
BAL	6	6	12	2	4	6	18	67%	33%	50%	67%	56%
BUF	7	6	13	3	6	9	22	59%	41%	46%	67%	55%
OAK	8	10	18	1	0	1	19	95%	5%	56%	0%	53%
NO	6	3	9	4	8	12	21	43%	57%	33%	67%	52%
HOU	5	3	8	1	3	4	12	67%	33%	38%	75%	50%
MIA	7	5	12	1	3	4	16	75%	25%	42%	75%	50%
IND	11	9	20	2	4	6	26	77%	23%	45%	67%	50%
NE	6	5	11	1	2	3	14	79%	21%	45%	67%	50%
DAL	7	6	13	1	2	3	16	81%	19%	46%	67%	50%
CAR	9	8	17	1	1	2	19	89%	11%	47%	50%	47%
SF	4	4	8	2	1	3	11	73%	27%	50%	33%	45%
CIN	8	3	11	0	3	3	14	79%	21%	27%	100%	43%
CLE	12	7	19	3	4	7	26	73%	27%	37%	57%	42%
WAS	10	8	18	4	2	6	24	75%	25%	44%	33%	42%
JAX	13	8	21	3	3	6	27	78%	22%	38%	50%	41%
GB	14	10	24	2	1	3	27	89%	11%	42%	33%	41%
DEN	6	5	11	7	3	10	21	52%	48%	45%	30%	38%
SEA	11	6	17	1	1	2	19	89%	11%	35%	50%	37%
ATL	12	8	20	4	1	5	25	80%	20%	40%	20%	36%
ARI	10	5	15	3	2	5	20	75%	25%	33%	40%	35%
DET	18	11	29	5	0	5	34	85%	15%	38%	0%	32%
TB	18	9	27	6	2	8	35	77%	23%	33%	25%	31%
TEN	9	4	13	2	1	3	16	81%	19%	31%	33%	31%
NYJ	12	2	14	0	2	2	16	88%	13%	14%	100%	25%
KC	10	3	13	1	0	1	14	93%	7%	23%	0%	21%
Totals	284	221	505	73	100	173	678	74%	26%	44%	58%	47%

Pass plays account for 75% of all 2-point conversion attempts, yet they are not nearly as successful as run plays (44% vs. 58% conversion)

Only 2 teams rushed the ball more than 50% of the time, indicating the distribution of pass/run is a league-wide preference, making game planning for these situations a bit easier

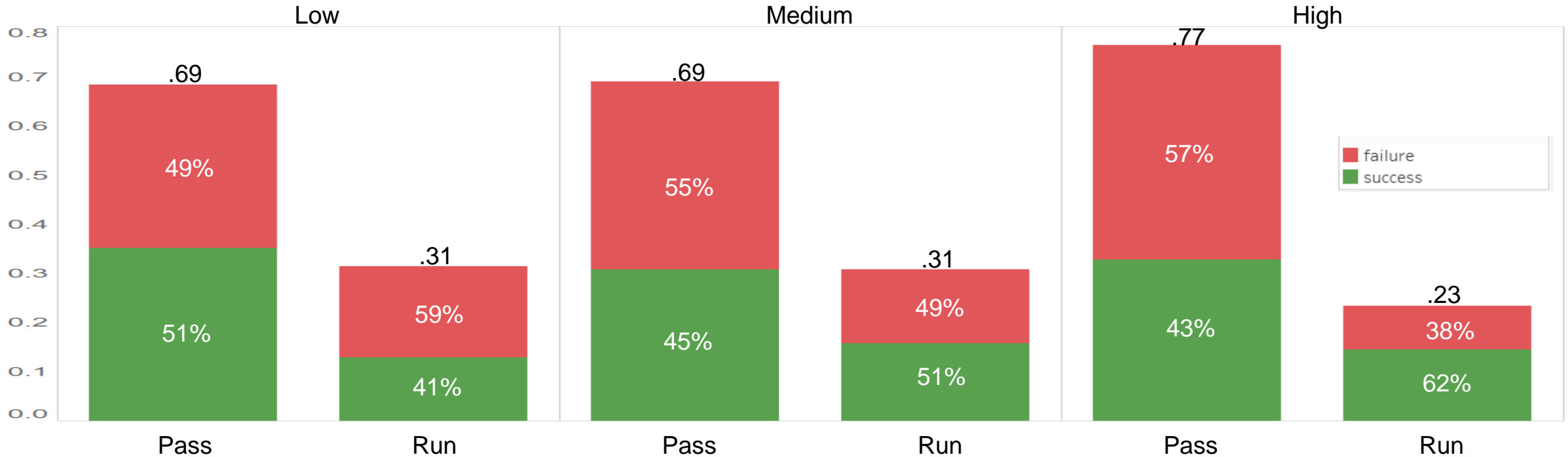
This figure can **potentially slightly underestimate the pass total** as not all QB runs could be confirmed as scrambles or designed runs¹

Appendix Exhibit 3 (2-Point Conversion Attempts)
 1- Appendix Exhibit 13 (QB Runs on 2-Point Conversions)



An analysis revealed that the 2-point attempt pass/rush play call frequency and effectiveness vary given the pressure of the situation in the game

2-Point Play Call Frequency and Conversion by Pressure



The disparity between pass and run play calls grows as the pressure mounts from low to high (pass frequency increases from 69% to 77%), but the effectiveness of passes decreases (51% to 43%) while the effectiveness of runs increases with pressure (41% to 62%)

Teams are adamant to place the ball in their quarterback's hands in crucial situations despite lower conversion

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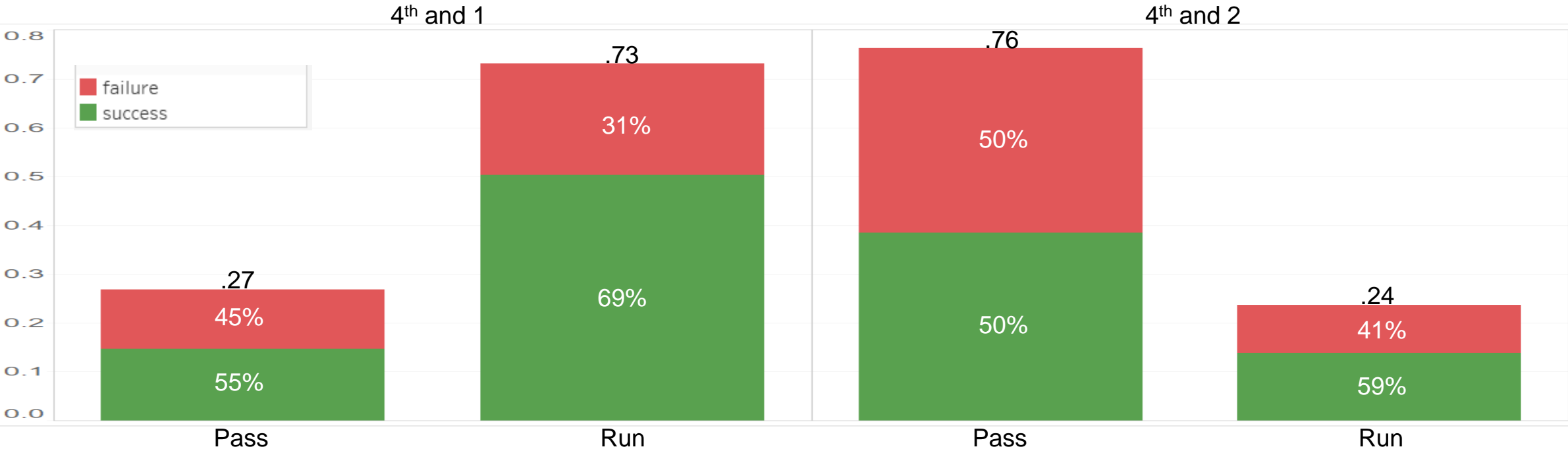
2-Point Attempts

4th Down Attempts

Takeaways

Analysis revealed a staggering difference in play calling tendencies and effectiveness on 4th and 1 vs. 4th and 2 situations

4th and Short Play Call Frequency and Conversion by Distance



1779 4th and 1 attempts & 541 4th and 2 attempts

On 4th and 1, 73% of attempts were **rushes**, converting 69% of the time (passes had a 55% conversion)

On 4th and 2, **passes** accounted for 76% of play calls, converting 50% of the time (runs converted 59%)

Key Takeaway – 1 yard makes all the difference in play calling – but why?



League-wide totals were broken down by team to better understand the distribution of pass/run plays and to identify potential outliers

4th and 1 Attempts – Team Breakdown

Teams	Pass - Fail	Pass - Success	Total Passes	Run - Fail	Run - Success	Total Runs	Total Attempts	% Passes	% Runs	Pass Success (%)	Run Success (%)	Total Success
ARI	3	7	10	6	23	29	39	26%	74%	70%	79%	77%
CAR	6	8	14	8	35	43	57	25%	75%	57%	81%	75%
CLE	7	5	12	8	34	42	54	22%	78%	42%	81%	72%
NYJ	1	7	8	14	32	46	54	15%	85%	88%	70%	72%
TEN	4	14	18	11	23	34	52	35%	65%	78%	68%	71%
PHI	7	11	18	18	49	67	85	21%	79%	61%	73%	71%
SEA	7	6	13	7	27	34	47	28%	72%	46%	79%	70%
CIN	4	4	8	14	38	52	60	13%	87%	50%	73%	70%
DAL	3	5	8	15	36	51	59	14%	86%	63%	71%	69%
NO	6	8	14	15	39	54	68	21%	79%	57%	72%	69%
NE	6	10	16	15	36	51	67	24%	76%	63%	71%	69%
KC	5	8	13	14	31	45	58	22%	78%	62%	69%	67%
SF	7	12	19	13	29	42	61	31%	69%	63%	69%	67%
DEN	7	13	20	11	22	33	53	38%	62%	65%	67%	66%
MIN	5	11	16	13	24	37	53	30%	70%	69%	65%	66%
CHI	6	8	14	12	27	39	53	26%	74%	57%	69%	66%
PIT	4	12	16	13	21	34	50	32%	68%	75%	62%	66%
LA	9	11	20	10	24	34	54	37%	63%	55%	71%	65%
HOU	5	14	19	18	27	45	64	30%	70%	74%	60%	64%
BAL	6	8	14	18	34	52	66	21%	79%	57%	65%	64%
JAX	12	5	17	16	43	59	76	22%	78%	29%	73%	63%
BUF	7	3	10	9	23	32	42	24%	76%	30%	72%	64%
LAC	2	4	6	14	22	36	42	14%	86%	67%	61%	62%
TB	7	7	14	15	26	41	55	25%	75%	50%	63%	60%
WAS	10	8	18	11	22	33	51	35%	65%	44%	67%	59%
OAK	9	9	18	15	24	39	57	32%	68%	50%	62%	58%
ATL	14	8	22	11	25	36	58	38%	62%	36%	69%	57%
GB	8	8	16	14	21	35	51	31%	69%	50%	60%	57%
DET	12	5	17	11	24	35	52	33%	67%	29%	69%	56%
MIA	7	4	11	16	25	41	52	21%	79%	36%	61%	56%
NYG	7	7	14	13	16	29	43	33%	67%	50%	55%	53%
IND	12	12	24	10	13	23	47	51%	49%	50%	57%	53%
Grand Total	215	262	477	408	895	1302	1779	27%	73%	55%	69%	65%

4th and 2 Attempts – Team Breakdown

Teams	Pass - Fail	Pass - Success	Total Passes	Run - Fail	Run - Success	Total Runs	Total Attempts	% Passes	% Runs	Pass Success (%)	Run Success (%)	Total Success
DET	5	9	14	0	6	6	20	70%	30%	64%	100%	75%
CIN	3	6	9	1	5	6	15	60%	40%	67%	83%	73%
PIT	1	7	8	2	0	2	10	80%	20%	88%	0%	70%
ATL	5	14	19	1	0	1	20	95%	5%	74%	0%	70%
NO	4	12	16	3	4	7	23	70%	30%	75%	57%	70%
IND	2	5	7	2	3	5	12	58%	42%	71%	60%	67%
LAC	3	7	10	2	3	5	15	67%	33%	70%	60%	67%
LA	2	5	7	1	1	2	9	78%	22%	71%	50%	67%
CAR	3	8	11	3	2	5	16	69%	31%	73%	40%	63%
NE	4	8	12	1	0	1	13	92%	8%	67%	0%	62%
MIA	6	7	13	0	1	1	14	93%	7%	54%	100%	57%
DEN	6	6	12	2	4	6	18	67%	33%	50%	67%	56%
PHI	6	7	13	2	3	5	18	72%	28%	54%	60%	56%
SF	6	8	14	2	2	4	18	78%	22%	57%	50%	56%
CLE	6	10	16	3	1	4	20	80%	20%	63%	25%	55%
BAL	8	8	16	2	3	5	21	76%	24%	50%	60%	52%
NYG	10	13	23	2	0	2	25	92%	8%	57%	0%	52%
TEN	7	4	11	1	4	5	16	69%	31%	36%	80%	50%
NYJ	4	6	10	2	0	2	12	83%	17%	60%	0%	50%
DAL	7	5	12	0	2	2	14	86%	14%	42%	100%	50%
MIN	8	5	13	0	2	2	15	87%	13%	38%	100%	47%
TB	8	5	13	0	2	2	15	87%	13%	38%	100%	47%
ARI	11	5	16	0	4	4	20	80%	20%	31%	100%	45%
KC	9	4	13	1	4	5	18	72%	28%	31%	80%	44%
WAS	12	10	22	3	1	4	26	85%	15%	45%	25%	42%
HOU	7	4	11	3	3	6	17	65%	35%	36%	50%	41%
JAX	7	1	8	1	4	5	13	62%	38%	13%	80%	38%
CHI	7	5	12	1	0	1	13	92%	8%	42%	0%	38%
GB	9	2	11	4	5	9	20	55%	45%	18%	56%	35%
BUF	12	7	19	3	1	4	23	83%	17%	37%	25%	35%
SEA	8	2	10	2	3	5	15	67%	33%	20%	60%	33%
OAK	9	3	12	3	2	5	17	71%	29%	25%	40%	29%
Grand Total	205	208	413	53	75	128	541	76%	24%	50%	59%	52%

Only one team passed on the majority of their 4th and 1 attempts (Colts passed 51% of the time, and they had the worst conversion rate), indicating a league-wide preference to run the ball in this situation (76% of all attempts)

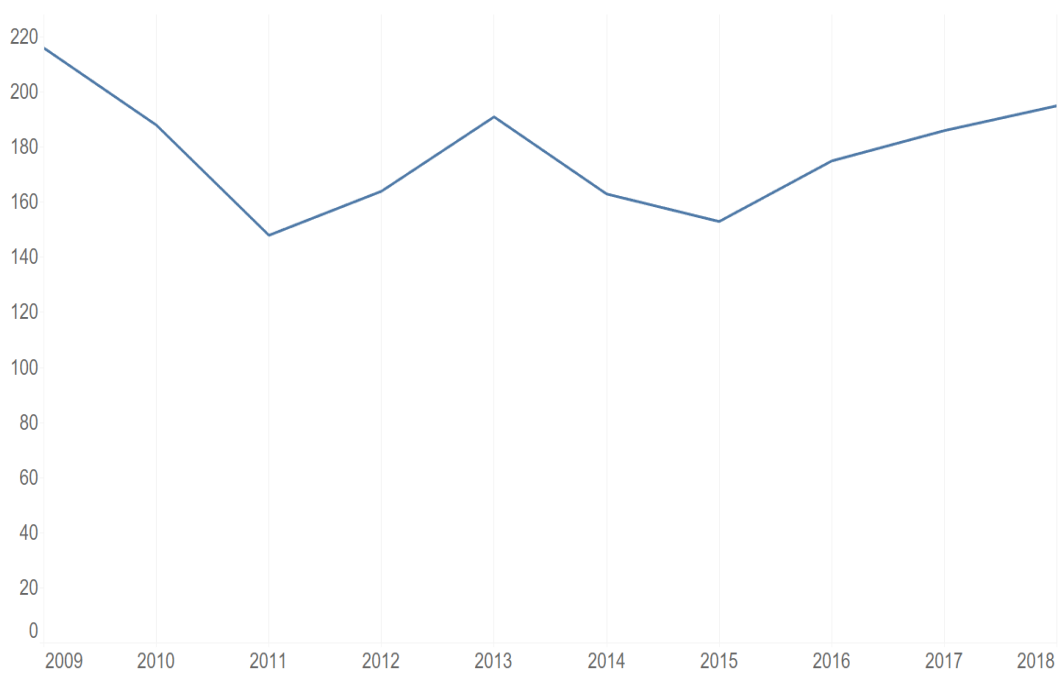
No teams ran the ball more than 50% of the time on 4th and 2

Teams can better prepare for these situations in the beginning of the season knowing the league-wide preference in play call



Though the total number of 4th and 1 attempts showed no clear trend, there was a noticeable increase in attempts as a % of total opportunities in 2018

4th and 1 Attempts by Season



League-wide data (1779 attempts)

4th and 1 Attempts – Ratio Analysis

4 th and 1 Attempts	2009-2017 (Average)	2018	2018 % Growth	FY
# of Attempts	176.00	195.00	10.80%	234.19
Total Opportunities	420.33	350.00	-16.73%	420.33
Attempts per Opportunity	41.87%	55.71%	33.06%	55.71%
Attempts per Team	5.50	6.09	10.80%	7.32

Total Opportunities = Total Number of 4th and 1 situations

FY = Forward Year Estimate

A stark increase in the attempts per opportunity indicates more aggressive play calling and/or more critical situations on 4th and 1

If the 2018 rate were to stay constant, and if total opportunities returns to the average amount, it is fair to expect an increase of nearly 40 attempts in a given year

Key Takeaway - 4th and 1 situations will become increasingly important for defenses to prepare for, and teams will likely face 3.64 more attempts on average (1.82 offensively, 1.82 defensively) per 16 game season than in the previous 9 years

A deeper dive revealed changes in willingness to attempt 4th and 1 opportunities given the pressure of the situation and the position on the field

4th and 1 Attempts as a % of Total Opportunities – by Pressure and Field Position

4 th and 1	2009-2017 Average				2018 Values				2018 % Change from Average			
	Low	Medium	High	Total	Low	Medium	High	Total	Low	Medium	High	Total
Inside own 40	4.60%	4.20%	27.19%	10.73%	7.69%	5.88%	33.33%	15.09%	67.40%	40.14%	22.59%	40.68%
Own 40-49	16.88%	17.74%	51.72%	27.41%	28.00%	42.86%	63.64%	40.00%	65.85%	141.56%	23.03%	45.93%
Opp 41-50	50.00%	52.21%	70.09%	56.64%	84.62%	95.00%	87.50%	90.24%	69.23%	81.97%	24.85%	59.32%
Opp 31-40	80.67%	82.31%	84.75%	82.56%	77.78%	85.71%	75.00%	78.57%	-3.59%	4.14%	-11.50%	-4.83%
Opp 21-30	68.47%	52.68%	75.00%	64.89%	63.64%	87.50%	75.00%	74.07%	-7.06%	66.10%	0.00%	14.15%
Opp 11-20	47.96%	51.96%	59.78%	53.08%	66.67%	85.71%	60.00%	71.05%	39.01%	64.96%	0.36%	33.85%
Opp 1-10	65.16%	59.81%	69.79%	64.79%	86.67%	92.00%	85.00%	88.33%	33.01%	53.82%	21.79%	36.34%
Total	35.86%	36.33%	55.63%	41.87%	44.63%	61.48%	61.68%	55.71%	24.44%	69.22%	10.89%	33.06%

Opp = Opponent's side of the field

Appendix Exhibit 7 (Pressure and Field Position Analysis)

Team's willingness to attempt a 4th and 1 has increased at almost all points on the field with the **biggest spike between the 40s** (intuitively, this makes sense, as this is too far to kick a field goal, and punts will net fewer yards when kicked from here)

When considering pressure, the largest % changes occurred in medium and low pressure situations (69% and 24% increase from average), indicating the increase in relative attempts is the result of more aggressive play calling and not due to a close game

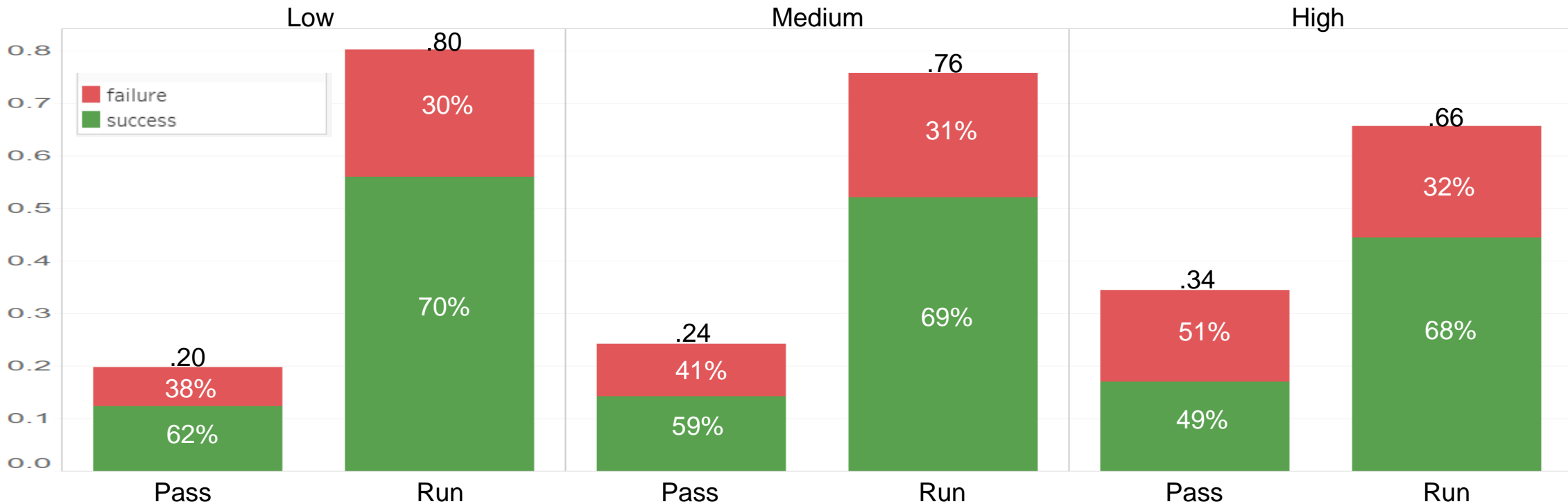
Teams need to prepare to defend against 4th and 1, as it is becoming increasingly common to go for it, especially around mid field

Appendix Exhibit 11 (4th and 1 by Pressure and Field Position Over Time)



Like 2-point conversions, pressure is a large influencer on play call tendencies and conversion rate for 4th and 1 situations

4th and 1 Play Call Frequency and Conversion by Pressure



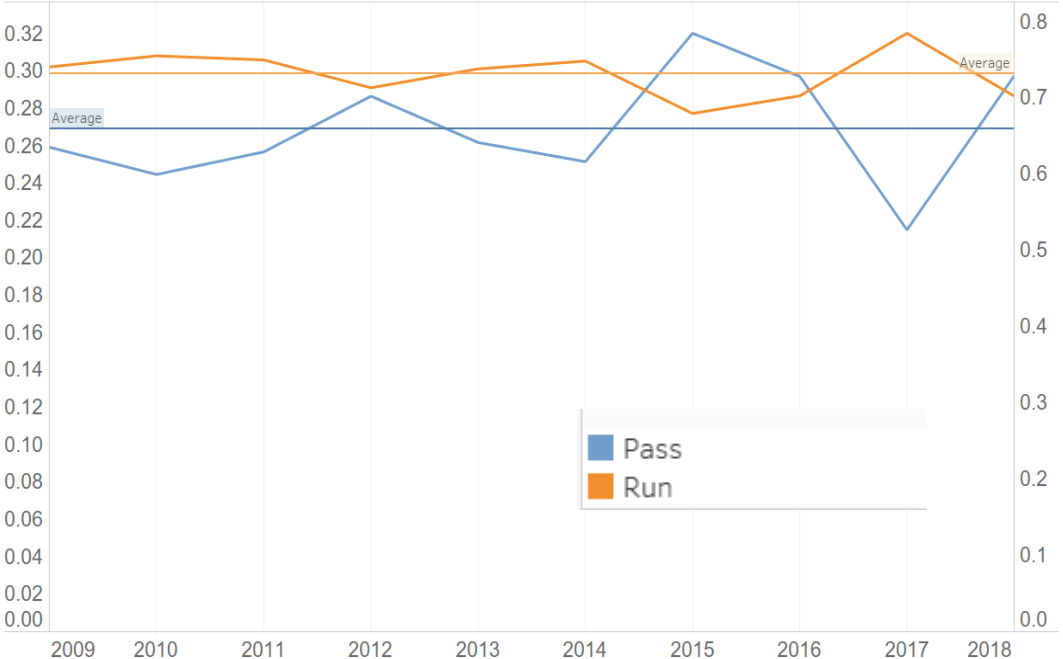
Play calls greatly shift with pressure (80%-20% run/pass when low vs. 66%-34% run/pass when high)

Pass conversion seems to be more influenced by pressure (62% to 50% for passes, 70% to 68% for runs)

Teams should be more confident in running the ball – especially in crucial situations

The ratio of pass to run plays has remained fairly steady over 10 years with a slight increase in the relative number of pass plays in recent years

4th and 1 Play Call Frequency by Season



Pass on left axis and run on right axis

4th and 1 Attempts – Conversion over time

4 th and 1 Attempts	2009-2017 (Average)	2018	2018 % Growth
% Pass Attempts	26.45%	29.76%	12.44%
% Run Attempts	73.55%	70.24%	-4.48%
Pass Conversion	53.94%	62.07%	15.07%
Run Conversion	67.81%	76.64%	13.02%

In 2018, the split of **runs to passes** was 70%-30% indicating a shift towards passes relative to the 9 year average of 74%-26%

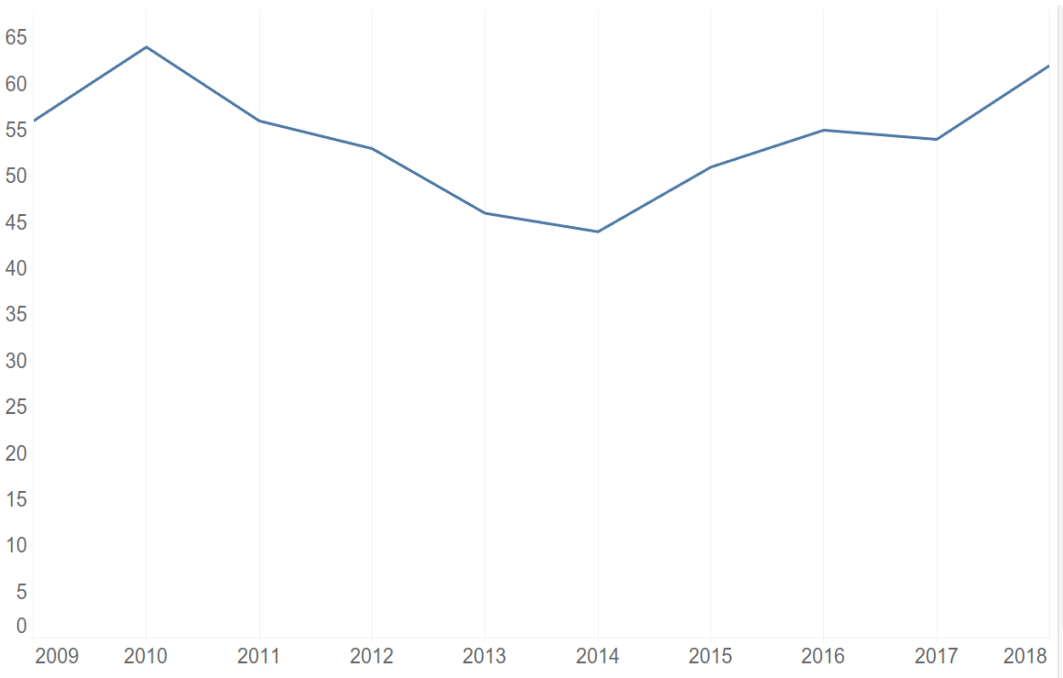
Interestingly, the conversion rate of each play type is at a 10-year high (77% for runs vs. 68% 10 year average, and 62% for passes vs. 54% 10 year average)

Teams are becoming more successful in 4th and 1 situations and should continue to increase aggression



Total 4th and 2 attempts has been slowly rising since 2014, and there was a nontrivial increase in attempts as a % of total opportunities in 2018

4th and 2 Attempts by Season



League-wide data (541 attempts)

4th and 2 Attempts – Ratio Analysis

4 th and 2 Attempts	2009-2017 (Average)	2018	2018 % Growth	FY
# of Attempts	53.22	62.00	16.49%	79.22
Total Opportunities	299.00	234.00	-21.74%	420.33
Attempts per Opportunity	17.80%	26.50%	48.85%	26.50%
Attempts per Team	1.66	1.94	16.49%	2.48

Total Opportunities = Total Number of 4th and 2 situations
 FY = Forward Year Estimate

Despite 22% fewer 4th and 2 opportunities, the total attempts rose 16% and attempts per opportunity rose nearly 49%, signaling more aggressive play calling and/or more critical situations when a team faced 4th and 2

If the 2018 rate stays constant, and if total opportunities returns to average, it is fair to expect an increase of 17 attempts in a given year

Key Takeaway - 4th and 2 situations are attempted more frequently now, and teams will likely face this situation on average 4.96 times a year (half offensively, half defensively), 49% more frequently than the 9 year average of 3.33 times a year



A deeper dive revealed changes in willingness to attempt 4th and 2 opportunities given the pressure of the situation and the position on the field

4th and 2 Attempts as a % of Total Opportunities – by Pressure and Field Position

4 th and 2	2009-2017 Average				2018 Values				2018 % Change from Average			
	Low	Medium	High	Total	Low	Medium	High	Total	Low	Medium	High	Total
Inside own 40	0.30%	2.03%	16.88%	5.39%	2.63%	6.90%	35.71%	9.88%	763.16%	239.08%	111.54%	83.36%
Own 40-49	3.01%	6.99%	24.78%	10.19%	0.00%	11.11%	60.00%	20.00%	-100.00%	58.89%	142.14%	96.28%
Opp 41-50	12.22%	16.19%	50.60%	25.18%	33.33%	50.00%	80.00%	52.17%	172.73%	208.82%	58.10%	107.20%
Opp 31-40	40.74%	51.81%	60.47%	51.20%	85.71%	0.00%	72.73%	66.67%	110.39%	-100.00%	20.28%	30.21%
Opp 21-30	24.73%	12.50%	34.67%	24.17%	0.00%	9.09%	71.43%	26.09%	-100.00%	-27.27%	106.04%	7.95%
Opp 11-20	8.43%	14.08%	34.18%	18.88%	0.00%	50.00%	75.00%	41.18%	-100.00%	255.00%	119.44%	118.05%
Opp 1-10	7.91%	14.50%	41.67%	21.74%	16.67%	15.79%	44.44%	23.53%	110.61%	8.86%	6.67%	8.24%
Total	9.29%	12.67%	33.79%	17.80%	12.05%	18.68%	58.33%	26.50%	29.75%	47.48%	72.66%	48.85%

Opp = Opponent's side of the field

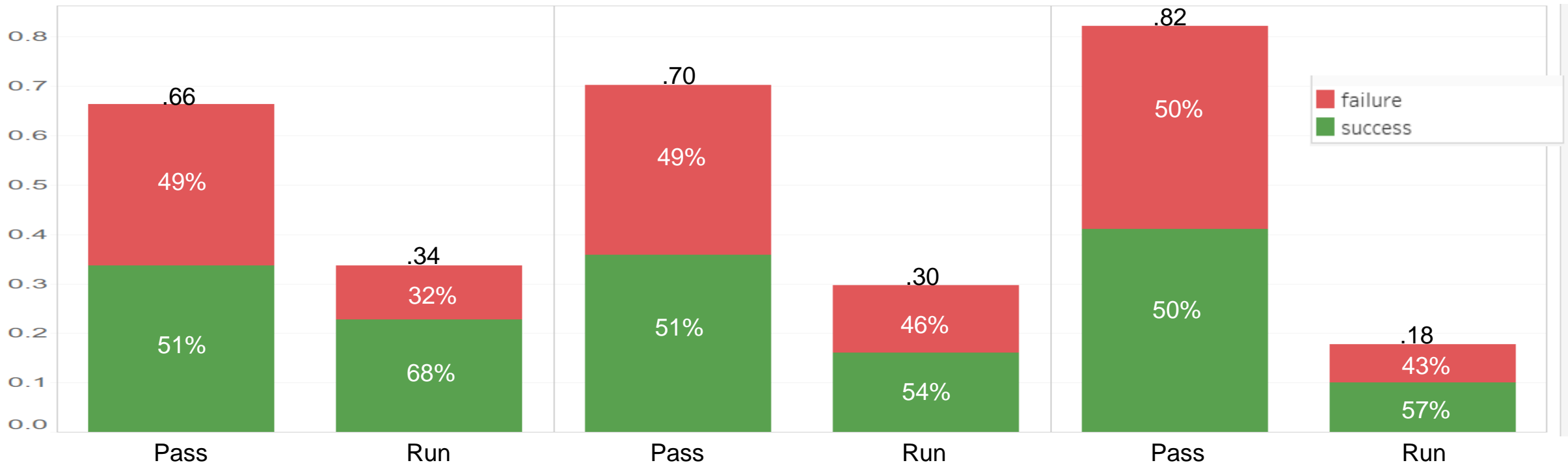
Team's willingness to attempt a 4th and 2 has increased at all points on the field, and on the aggregate, in all situations in the game

When considering pressure, the largest % changes occurred in high and medium pressure situations (73% and 47% increase from 9 year average), indicating the increase in relative attempts is the result of more aggressive play calling in crunch time

Defenses should take note as coaches are showing more confidence on 4th and 2, especially In higher stakes situations

Pressure creates the largest disparity in play type frequency but has less influence on the conversion of play types in 4th and 2 situations

4th and 2 Play Call Frequency and Conversion by Pressure



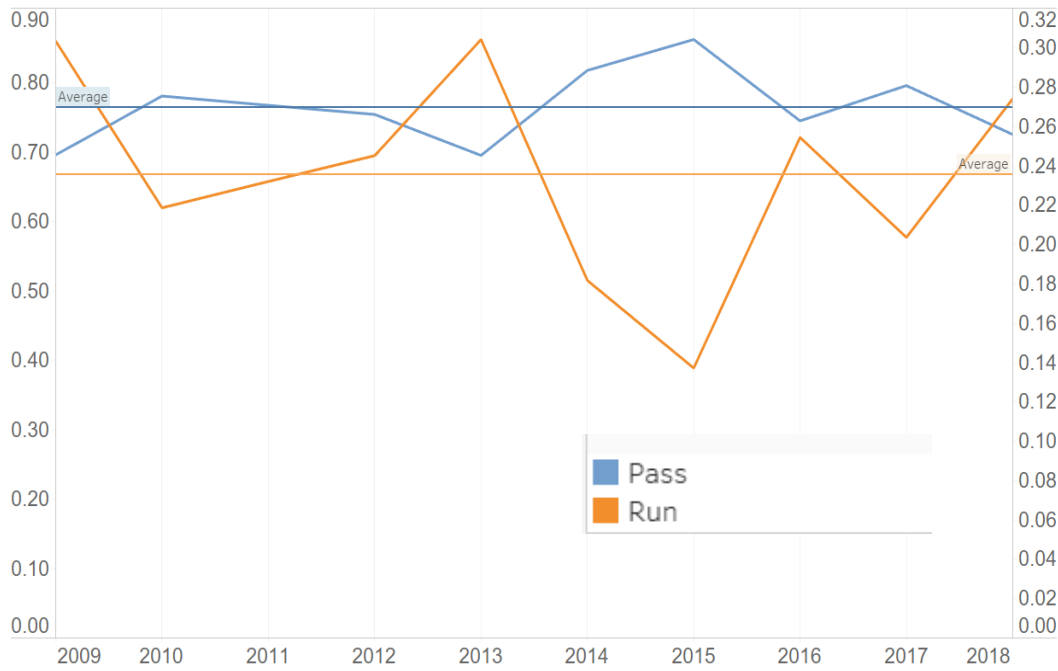
Passes are **overwhelmingly preferred** with increased pressure (66%-34% **pass/run split** when low vs. 82%-18% when high)

Though runs become less effective with pressure on 4th and 2, **pass conversion seems to not be greatly influenced**, and the relationship is less clear (51% to 50% pass conversion when pressure is low vs. high, and 68% to 57% run conversion)

Teams are leaning heavily on passing the ball (perhaps too much, and telegraphing their decision in high pressure situations), yet runs are still a very viable and underutilized option in this situation and should be used more often

While difficult to identify a clear trend over the past 10 years, passes have accounted for $\frac{3}{4}$ of all attempts over the past 10 years on 4th and 2

4th and 2 Play Call Frequency by Season



Pass on left axis and run on right axis

In 2018, the split of **passes to runs** was 74%-26% with a 9 year average of 77%-23% (fairly steady)

The effectiveness of both runs and passes has risen substantially above their 10 year averages (60% conversion for passes in 2018 vs 49% average, and 65% for runs vs. 58% average)

Teams are becoming more successful in 4th and 2 situations and should look to be more aggressive

4th and 2 Attempts – Conversion over time

4 th and 2 Attempts	2009-2017 (Average)	2018	2018 % Growth
% Pass Attempts	76.78%	73.77%	-5.53%
% Run Attempts	23.28%	26.23%	18.32%
Pass Conversion	49.18%	60.00%	21.99%
Run Conversion	57.66%	64.71%	12.22%

Contents

Overview

2-Point Attempts

4th Down Attempts

Takeaways

Offensive coaches should alter their approach to short yardage situations

Be More Aggressive

Data shows growing success on 4th and short situations, so continue to exploit this opportunity until defenses improve in these situations

Reconsider Play Mix

The distribution of play calls is often 75%-25% (pass/run in 4th and 2 and 2-point conversions, and 73% run on 4th and 1) which becomes predictable, especially if your offense heavily relies on a few players

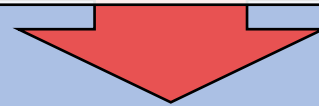
When in doubt, Run the ball!!!

Has proven to be more successful in all short-yardage situations outlined in this study, yet is only the preferred play call on 4th and 1 situations

Defensive coaches should leverage data to prepare for short yardage situations

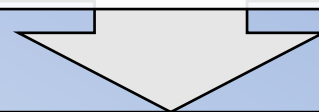
2-Point & 4th and short attempts will become increasingly important

Attempts have skyrocketed recently on a % basis and totals will rise in the future, so this play should be a bigger part in game plans



Identify opposing team's tendencies

These are not coin-flip scenarios, data suggests the offensive team will **heavily favor a play call** in these situations



Reconsider personnel and schematic approach for these situations

An optimal roster can be built to defend in these situations, and defensive alignment and play calling can be enhanced for these scenarios (**more data can be useful here – i.e “4-man front, B-gap blitz, other schemes that prove effective against these plays)**)

Potential Next Steps

- The procedure and findings serve to guide further analysis to reveal additional insight (either league-wide or team-specific)
- Analysis such as player utilization, route distance, preferred side to target with the ball (right/left/middle) can all be performed (both in and outside of these short yardage situations)
- Happy to follow up with more information

patjwalsh35@gmail.com

<https://www.linkedin.com/in/patrick-walsh-540a01138/>

Appendix



Data

Exhibit 1 – Kaggle Data



The screenshot shows the Kaggle dataset page for "Detailed NFL Play-by-Play Data 2009-2018". The page features a background image of an NFL game. The dataset title is prominently displayed in white text. Below the title, a subtitle reads "nflscrapR generated NFL dataset with expected points and win probability". The creator's name, "Max Horowitz", and the update information, "updated a year ago (Version 6)", are visible. A navigation bar at the bottom includes links for "Data", "Tasks", "Kernels (1,237)", "Discussion (23)", "Activity", and "Metadata". On the right side of the navigation bar, there is a "Download (1 GB)" link and a "New Notebook" button. A yellow badge in the top right corner of the dataset card indicates 443 votes.

Dataset

Detailed NFL Play-by-Play Data 2009-2018

nflscrapR generated NFL dataset with expected points and win probability

Max Horowitz • updated a year ago (Version 6)

Data Tasks Kernels (1,237) Discussion (23) Activity Metadata

Download (1 GB) [New Notebook](#)

The data can be found at (<https://www.kaggle.com/maxhorowitz/nflplaybyplay2009to2016>)

The data has been updated since its creation to include 2017 and 2018 values

Started with a dataset of 255 columns and 450k rows and multiple questions to explore

```
Select * From [TestDB].[dbo].[NFL Data 2009-2018];
```

100 %

Results Messages

	play_id	game_id	home_team	away_team	posteam	posteam_type	defteam	side_of_field	yardline_100	game_date	quarter_seconds_remaining	half_seconds_remaining	game_seconds_remaining	game_half	quarter_end	drive
1	2458	2009092001	DET	MIN	DET	home	MIN	DET	66	2009-09-20 00:00:00.000	348	1248	1248	Half2	0	15
2	2482	2009092001	DET	MIN	DET	home	MIN	DET	58	2009-09-20 00:00:00.000	307	1207	1207	Half2	0	15
3	2507	2009092001	DET	MIN	MIN	away	DET	MIN	71	2009-09-20 00:00:00.000	293	1193	1193	Half2	0	16
4	2528	2009092001	DET	MIN	MIN	away	DET	MIN	71	2009-09-20 00:00:00.000	259	1159	1159	Half2	0	16
5	2552	2009092001	DET	MIN	MIN	away	DET	MIN	74	2009-09-20 00:00:00.000	216	1116	1116	Half2	0	16
6	2571	2009092001	DET	MIN	MIN	away	DET	MIN	80	2009-09-20 00:00:00.000	192	1092	1092	Half2	0	16
7	2594	2009092001	DET	MIN	DET	home	MIN	DET	63	2009-09-20 00:00:00.000	183	1083	1083	Half2	0	17
8	2615	2009092001	DET	MIN	DET	home	MIN	DET	56	2009-09-20 00:00:00.000	149	1049	1049	Half2	0	17
9	2636	2009092001	DET	MIN	DET	home	MIN	DET	51	2009-09-20 00:00:00.000	115	1015	1015	Half2	0	17
10	2660	2009092001	DET	MIN	DET	home	MIN	MIN	43	2009-09-20 00:00:00.000	91	991	991	Half2	0	17
11	2681	2009092001	DET	MIN	DET	home	MIN	MIN	42	2009-09-20 00:00:00.000	55	955	955	Half2	0	17
12	2703	2009092001	DET	MIN	DET	home	MIN	MIN	42	2009-09-20 00:00:00.000	49	949	949	Half2	0	17
13	2730	2009092001	DET	MIN	MIN	away	DET	MIN	83	2009-09-20 00:00:00.000	41	941	941	Half2	0	18
14	2754	2009092001	DET	MIN	NA	NA	NA	MIN	NULL	2009-09-20 00:00:00.000	0	900	900	Half2	1	18
15	2770	2009092001	DET	MIN	MIN	away	DET	MIN	77	2009-09-20 00:00:00.000	900	900	900	Half2	0	18
16	2794	2009092001	DET	MIN	MIN	away	DET	MIN	67	2009-09-20 00:00:00.000	860	860	860	Half2	0	18

Query executed successfully. DESKTOP-99JT234\SQLEXPRESS ... DESKTOP-99JT234\patjw ... master | 00:00:43 | 449,371 rows



After narrowing the focus to a few experimental questions worth exploring, the dataset was queried and prepared for analysis

SQL Query Editor showing a query to filter two-point conversion results:

```
Select * From dbo.[NFL Data 2009-2018] Where [two_point_conv_result] IN ('success', 'failure');
```

Results table showing columns: conds_remaining, game_seconds_remaining, game_half, quarter_end, drive, sp, qtr, down, goal_to_go, time, ydln, ydstogo, ydsnet, desc, play_type, yards_gained, shotg.

conds_remaining	game_seconds_remaining	game_half	quarter_end	drive	sp	qtr	down	goal_to_go	time	ydln	ydstogo	ydsnet	desc	play_type	yards_gained	shotg
1	327	Half2	0	23	0	4	NULL	0	1899-12-30 05:27:00.000	BUF 2	0	80	(Pass formation) TWO-POINT CONVERSION ATTEMPT. B.L...	pass	0	0
2	11	Half2	0	21	0	4	NULL	0	1899-12-30 00:11:00.000	CIN 2	0	87	(Pass formation) TWO-POINT CONVERSION ATTEMPT. K...	pass	0	0
3	919	Half2	0	18	0	3	NULL	0	1899-12-30 00:19:00.000	JAC 2	0	80	TWO-POINT CONVERSION ATTEMPT. K.Collins pass to A.C...	pass	0	0
4	328	Half2	0	22	1	4	NULL	0	1899-12-30 05:28:00.000	JAC 2	0	77	TWO-POINT CONVERSION ATTEMPT. C.Johnson rushes le...	run	2	0
5	326	Half2	0	17	0	4	NULL	0	1899-12-30 05:26:00.000	WAS 2	0	85	TWO-POINT CONVERSION ATTEMPT. M.Stafford pass to B...	pass	0	0
6	554	Half2	0	16	0	4	NULL	0	1899-12-30 09:14:00.000	PIT 2	0	85	(Pass formation) TWO-POINT CONVERSION ATTEMPT. C.P...	pass	0	0
7	14	Half2	0	18	1	4	NULL	0	1899-12-30 00:14:00.000	PIT 2	0	71	(Pass formation) TWO-POINT CONVERSION ATTEMPT. C.P...	pass	2	0
8	220	Half2	0	18	0	4	NULL	1	1899-12-30 03:40:00.000	MIN 1	0	96	TWO-POINT CONVERSION ATTEMPT. A.Rodgers pass to R...	pass	0	0
9	71	Half2	0	24	1	4	NULL	0	1899-12-30 01:11:00.000	CHI 2	0	72	TWO-POINT CONVERSION ATTEMPT. A.Rodgers pass to G...	pass	2	0
10	667	Half2	0	15	0	4	NULL	0	1899-12-30 11:07:00.000	IND 2	0	58	TWO-POINT CONVERSION ATTEMPT. M.Jones-Drew rush...	run	0	0
11	566	Half2	0	20	0	4	NULL	0	1899-12-30 09:26:00.000	NYG 3	0	48	TWO-POINT CONVERSION ATTEMPT. M.Cassel rushes up...	run	0	0
12	112	Half2	0	23	1	4	NULL	0	1899-12-30 01:52:00.000	SEA 2	0	71	TWO-POINT CONVERSION ATTEMPT. J.Cutler pass to E.Be...	pass	2	0
13	831	Half2	0	14	1	4	NULL	0	1899-12-30 13:51:00.000	STL 2	0	82	TWO-POINT CONVERSION ATTEMPT. M.Stafford pass to M...	pass	2	0
14	126	Half2	0	16	0	4	NULL	0	1899-12-30 02:06:00.000	BUF 2	0	81	TWO-POINT CONVERSION ATTEMPT. T.Brady pass to B.W...	pass	0	0
15	50	Half2	0	18	0	4	NULL	0	1899-12-30 00:50:00.000	BUF 2	0	31	TWO-POINT CONVERSION ATTEMPT. T.Brady pass to R.M...	pass	0	0
16	1052	Half2	0	18	0	3	NULL	0	1899-12-30 02:32:00.000	DET 2	0	68	(Kick formation) TWO-POINT CONVERSION ATTEMPT. J.R...	pass	0	0

Query executed successfully. DESKTOP-99J7234\SQLEXPRESS ... DESKTOP-99J7234\patjw ... TestDB 00:00:00 696 rows

SQL Query Editor showing a query to filter down to 4 rows:

```
Select * From dbo.[NFL Data 2009-2018] Where [down] IN (4);
```

Results table showing columns: play_id, game_id, home_team, away_team, posteam, posteam_type, defteam, side_of_field, yardline_100, game_date, quarter_seconds_remaining, half_seconds_remaining, game_seconds_remaining, game_half, quarter_end, dr.

play_id	game_id	home_team	away_team	posteam	posteam_type	defteam	side_of_field	yardline_100	game_date	quarter_seconds_remaining	half_seconds_remaining	game_seconds_remaining	game_half	quarter_end	dr	
1	2402	2009092001	DET	MIN	DET	home	MIN	DET	58	2009-09-20 00:00:00.000	307	1207	1207	Half2	0	1f
2	2571	2009092001	DET	MIN	MIN	away	DET	MIN	80	2009-09-20 00:00:00.000	192	1092	1092	Half2	0	1f
3	2703	2009092001	DET	MIN	DET	home	MIN	MIN	42	2009-09-20 00:00:00.000	49	949	949	Half2	0	1f
4	2973	2009092001	DET	MIN	MIN	away	DET	DET	28	2009-09-20 00:00:00.000	601	601	601	Half2	0	1f
5	2612	2009092009	BUF	TB	BUF	home	TB	BUF	57	2009-09-20 00:00:00.000	697	1597	1597	Half2	0	1f
6	2729	2009092009	BUF	TB	TB	away	BUF	TB	69	2009-09-20 00:00:00.000	589	1499	1499	Half2	0	1f
7	2910	2009092009	BUF	TB	BUF	home	TB	BUF	74	2009-09-20 00:00:00.000	440	1340	1340	Half2	0	1f
8	3040	2009092009	BUF	TB	TB	away	BUF	BUF	43	2009-09-20 00:00:00.000	301	1201	1201	Half2	0	1f
9	4205	2009092709	BUF	NO	NO	away	BUF	BUF	17	2009-09-27 00:00:00.000	205	205	205	Half2	0	2f
10	4333	2009092709	BUF	NO	BUF	home	NO	BUF	86	2009-09-27 00:00:00.000	145	145	145	Half2	0	2f
11	3448	2009111600	CLE	BAL	BAL	away	CLE	BAL	51	2009-11-16 00:00:00.000	309	309	309	Half2	0	2f
12	3479	2009111600	CLE	BAL	BAL	away	CLE	BAL	56	2009-11-16 00:00:00.000	299	299	299	Half2	0	2f
13	3583	2009111600	CLE	BAL	CLE	home	BAL	CLE	83	2009-11-16 00:00:00.000	237	237	237	Half2	0	2f
14	3827	2009111600	CLE	BAL	BAL	away	CLE	CLE	37	2009-11-16 00:00:00.000	26	26	26	Half2	0	2f
15	1891	2009101100	BAL	CIN	BAL	home	CIN	CIN	49	2009-10-11 00:00:00.000	6	6	1806	Half1	0	9
16	2089	2009101100	RAI	CIN	RAI	home	CIN	RAI	55	2009-10-11 00:00:00.000	733	1633	1633	Half2	0	1f

Query executed successfully. DESKTOP-99J7234\SQLEXPRESS ... DESKTOP-99J7234\patjw ... TestDB 00:00:03 39,644 rows



Score differential and time remaining in the game were assessed to assign the “pressure” associated with each potential scenario in a game

Exhibit 2 – Pressure Scale

Pressure Scale				
Point Differential	Quarters			
	1	2	3	4
Trailing by ≥ 15 pts	Low	Medium	High	High
Winning by ≥ 15 pts	Low	Low	Low	Low
Trailing by between 9-14 pts	Low	Medium	Medium	High
Winning by between 9-14 pts	Low	Low	Medium	Medium
Trailing by ≤ 8 pts	Low	Medium	High	High
Winning by ≤ 8 pts	Low	Medium	Medium	High
Game is Tied	Low	Low	Medium	High

Score differential and time remaining in the game were assessed to assign the “pressure” at each potential scenario in a game

2-Point Conversion Attempt Analysis

Exhibit 3 – 2-Point Conversion Attempts

Metric	Low	Medium	High	Total
Success	26	56	239	321
Pass	19	37	166	222
Run	7	19	73	99
Failure	28	64	265	357
Pass	18	46	220	284
Run	10	18	45	73
Total	54	120	504	678
% Success	48.15%	46.67%	47.42%	47.35%
% of all attempts that are Passes	68.52%	69.17%	76.59%	74.63%
% of all attempt that are runs	31.48%	30.83%	23.41%	25.37%
% of Passes Successful	51.35%	44.58%	43.01%	43.87%
% of Runs Successful	41.18%	51.35%	61.86%	57.56%

Exhibit 4 – 2-Point Conversion Ratios

Touchdowns and 2-Point Attempts by Pressure By Year																
Touchdowns by Pressure By Year																
Row Labels	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Grand Total	2009-2014	2015-2017	2009-2014 Average	2015-2017 Average	% Growth in 2018
Touchdowns	1,170	1,275	1,247	1,373	1,335	1,288	1,238	1,285	1,304	1,279	12,794	7,688	3,827	1,281.33	1,275.67	0.26%
High	286	335	347	352	367	317	365	342	335	344	3,390	2,004	1,042	334.00	347.33	-0.96%
Low	520	521	539	584	525	551	498	512	526	556	5,332	3,240	1,536	540.00	512.00	8.59%
Medium	364	419	361	437	443	420	375	431	443	379	4,072	2,444	1,249	407.33	416.33	-8.97%
Grand Total	1,170	1,275	1,247	1,373	1,335	1,288	1,238	1,285	1,304	1,279	12,794	7,688	3,827	1,281.33	1,275.67	0.26%
2-Point Attempts "Went for it"																
Row Labels	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Grand Total	2009-2014	2015-2017	2009-2014 Average	2015-2017 Average	% Growth in 2018
High	43	43	37	41	56	40	59	60	50	75	504	260	169	43.33	56.33	33.14%
Low	2	1	3	4	2	4	6	8	7	17	54	16	21	2.67	7.00	142.86%
Medium	10	2	5	9	8	6	16	21	15	28	120	40	52	6.67	17.33	61.54%
Grand Total	55	46	45	54	66	50	81	89	72	120	678	316	242	52.67	80.67	48.76%
"Did not go for it"																
Row Labels	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Grand Total	2009-2014	2015-2017	2009-2014 Average	2015-2017 Average	% Growth in 2018
High	243	292	310	311	311	277	306	282	285	269	2,886	1,744	873	290.67	291.00	-7.56%
Low	518	520	536	580	523	547	492	504	519	539	5,278	3,224	1,515	537.33	505.00	6.73%
Medium	354	417	356	428	435	414	359	410	428	351	3,952	2,404	1,197	400.67	399.00	-12.03%
Grand Total	1,115	1,229	1,202	1,319	1,269	1,238	1,157	1,196	1,232	1,159	12,116	7,372	3,585	1,229	1,195	-3.01%
Attempts Per Touchdown																
2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Grand Total	2009-2014	2015-2017	2009-2014 Average	2015-2017 Average	% Growth in 2018	
4.70%	3.61%	3.61%	3.93%	4.94%	3.88%	6.54%	6.93%	5.52%	9.38%	5.30%	4.11%	6.32%	4.11%	6.32%	48.37%	
% Growth from Previous Period																
-23.25%	0.02%	8.99%	25.70%	-21.48%	68.54%	5.86%	-20.28%	48.37%							53.84%	48.37%
Attempts Per Team																
1.72	1.44	1.41	1.69	2.06	1.56	2.53	2.78	2.25	3.75	2.12				1.65	2.52	48.76%

Exhibit 4 – 2-Point Conversion Ratios (Continued)

Grand Total	Trailing 9 Year Average				2009-2014 Average				2015-2017 Average				Change from 2015-2017 Average			
	Low	Medium	High	Total	Low	Medium	High	Overall	Low	Medium	High	Overall	Low	Medium	High	Overall
678.00	4.11	10.22	47.67	62.00	16.00	40.00	260.00	316.00	21.00	52.00	169.00	242.00	123.64%	77.45%	34.43%	48.37%
12116.00	526.56	400.11	290.78	1217.44	3224.00	2404.00	1744.00	7372.00	1515.00	1197.00	873.00	3585.00				
12794.00	530.67	410.33	338.44	1279.44	3240.00	2444.00	2004.00	7688.00	1536.00	1249.00	1042.00	3827.00				
5.30%	0.77%	2.49%	14.08%	4.85%	0.49%	1.64%	12.97%	4.11%	1.37%	4.16%	16.22%	6.32%				
	4.85%				4.11%				6.32%							



4th and Short Analysis

Exhibit 5 – 4th and 1 Attempts

4th and 1	Low	Medium	High	Total
Success	376	358	423	1157
Pass	68	77	117	262
Run	308	281	306	895
Failure	174	182	266	622
Pass	41	54	120	215
Run	133	128	146	407
Total	550	540	689	1779
% Success	68%	66%	61%	65%
% of all attempts that are Passes	20%	24%	34%	27%
% of all attempt that are runs	80%	76%	66%	73%
% of Passes Successful	62%	59%	50%	55%
% of Runs Successful	70%	69%	68%	69%

Exhibit 6 – 4th and 2 Attempts

4th and 2	Low	Medium	High	Total
Success	57	68	156	283
Pass	34	47	125	208
Run	23	21	31	75
Failure	44	63	149	258
Pass	33	45	126	205
Run	11	18	23	53
Total	101	131	305	541
% Success	56%	52%	51%	52%
% of all attempts that are Passes	66%	70%	82%	76%
% of all attempt that are runs	34%	30%	18%	24%
% of Passes Successful	51%	51%	50%	50%
% of Runs Successful	68%	54%	57%	59%

Exhibit 7 – 4th and 1 Over Time

4th and 1 Conversion Over Time	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total	2009-2013	2014-2018	9 Year Total	9 Year Average	Change from Average
Success	139	130	81	106	122	107	99	111	121	141	1157	578	579	1016	112.89	24.90%
Pass	29	25	20	27	27	24	27	26	21	36	262	128	134	226	25.11	43.36%
Run	110	105	61	79	95	83	72	85	100	105	895	450	445	790	87.78	19.62%
Failure	77	58	67	58	69	56	54	64	65	54	622	329	293	568	63.11	-14.44%
Pass	27	21	18	20	23	17	22	26	19	22	215	109	106	193	21.44	2.59%
Run	50	37	49	38	46	39	32	38	46	32	407	220	187	375	41.67	-23.20%
Total	216	188	148	164	191	163	153	175	186	195	1779	907	872	1584	176	10.80%
% Success	64%	69%	55%	65%	64%	66%	65%	63%	65%	72%	65%	64%	66%	64%	64%	12.73%
% of all attempts that are Passes	25.93%	24.47%	25.68%	28.66%	26.18%	25.15%	32.03%	29.71%	21.51%	29.74%	26.81%	26.13%	27.52%	26.45%	26.45%	12.44%
% of all attempt that are runs	74.07%	75.53%	74.32%	71.34%	73.82%	74.85%	67.97%	70.29%	78.49%	70.26%	73.19%	73.87%	72.48%	73.55%	73.55%	-4.48%
% of Passes Successful	51.79%	54.35%	52.63%	57.45%	54.00%	58.54%	55.10%	50.00%	52.50%	62.07%	54.93%	54.01%	55.83%	53.94%	53.94%	15.07%
% of Runs Successful	68.75%	73.94%	55.45%	67.52%	67.38%	68.03%	69.23%	69.11%	68.49%	76.64%	68.74%	67.16%	70.41%	67.81%	67.81%	13.02%

Exhibit 8 – 4th and 2 Over Time

4th and 2 Conversion Over Time	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total	2009-2013	2014-2018	9 Year Total	9 Year Average	Change from Average
Success	21	32	22	30	29	26	25	33	27	38	283	134	149	245	27.22	39.59%
Pass	14	26	13	19	17	20	21	29	22	27	208	89	119	181	20.11	34.25%
Run	7	6	9	11	12	6	4	4	5	11	75	45	30	64	7.11	54.69%
Failure	35	32	34	23	17	18	26	22	27	24	258	141	117	234	26.00	-7.69%
Pass	25	24	30	21	15	16	23	12	21	18	205	115	90	187	20.78	-13.37%
Run	10	8	4	2	2	2	3	10	6	6	53	26	27	47	5.22	14.89%
Total	56	64	56	53	46	44	51	55	54	62	541	275	266	479	53.22	16.49%
% Success	38%	50%	39%	57%	63%	59%	49%	60%	50%	61%	52%	49%	56%	51%	51%	19.83%
% of all attempts that are Passes	69.64%	78.13%	76.79%	75.47%	69.57%	81.82%	86.27%	74.55%	79.63%	72.58%	76.34%	74.18%	78.57%	76.83%	76.83%	-5.53%
% of all attempt that are runs	30.36%	21.88%	23.21%	24.53%	30.43%	18.18%	13.73%	25.45%	20.37%	27.42%	23.66%	25.82%	21.43%	23.17%	23.17%	18.32%
% of Passes Successful	35.90%	52.00%	30.23%	47.50%	53.13%	55.56%	47.73%	70.73%	51.16%	60.00%	50.36%	43.63%	56.94%	49.18%	49.18%	21.99%
% of Runs Successful	41.18%	42.86%	69.23%	84.62%	85.71%	75.00%	57.14%	28.57%	45.45%	64.71%	58.59%	63.38%	52.63%	57.66%	57.66%	12.22%



4th and Short Analysis

Exhibit 9 - 4th and 1 By Pressure Over Time

4th and 1 by Year w/Pressure	2009			2010			2011			2012			2013			2014			2015			2016			2017			2018			Total			10 Year Total
	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High	
Success	54	36	49	49	36	45	20	27	34	37	34	35	31	33	58	31	31	45	37	28	34	29	45	37	48	36	37	40	52	49	376	358	423	1157
Pass	13	5	11	5	9	11	5	8	7	8	5	14	5	3	19	6	8	10	6	10	11	4	13	9	9	3	9	7	13	16	68	77	117	262
Run	41	31	38	44	27	34	15	19	27	29	29	21	26	30	39	25	23	35	31	18	23	25	32	28	39	33	28	33	39	33	308	281	306	895
Failure	30	15	32	14	18	26	21	13	33	12	16	30	19	21	29	11	16	29	20	16	18	15	28	21	18	16	31	14	23	17	174	182	266	622
Pass	8	4	15	5	4	12	3	3	12	2	4	14	7	4	12	1	7	9	5	4	13	3	13	10	3	3	13	4	8	10	41	54	120	215
Run	22	11	17	9	14	14	18	10	21	10	12	16	12	17	17	10	9	20	15	12	5	12	15	11	15	13	18	10	15	7	133	128	146	407
Total	84	51	81	63	54	71	41	40	67	49	50	65	50	54	87	42	47	74	57	44	52	44	73	58	66	52	68	54	75	66	550	540	689	1779
% Success	64%	71%	60%	78%	67%	63%	49%	68%	51%	76%	68%	54%	62%	61%	67%	74%	66%	61%	65%	64%	65%	66%	62%	64%	73%	69%	54%	74%	69%	74%	68%	66%	61%	65%
% of all attempts that are Passes	25%	18%	32%	16%	24%	32%	20%	28%	28%	20%	18%	43%	24%	13%	36%	17%	32%	26%	19%	32%	46%	16%	36%	33%	18%	12%	32%	20%	28%	39%	20%	24%	34%	27%
% of all attempt that are runs	75%	82%	68%	84%	76%	68%	80%	73%	72%	80%	82%	57%	76%	87%	64%	83%	68%	74%	81%	68%	54%	84%	64%	67%	82%	88%	68%	80%	72%	61%	80%	76%	66%	73%
% of Passes Successful	62%	56%	42%	50%	69%	48%	63%	73%	37%	80%	56%	50%	42%	43%	61%	86%	53%	53%	55%	71%	46%	57%	50%	47%	75%	50%	41%	64%	62%	62%	62%	59%	49%	55%
% of Runs Successful	65%	74%	69%	83%	66%	71%	45%	66%	56%	74%	71%	57%	68%	64%	70%	71%	72%	64%	67%	60%	82%	68%	68%	72%	72%	72%	61%	77%	72%	83%	70%	69%	68%	69%

Exhibit 10 - 4th and 2 By Pressure Over Time

4th and 2 by Year w/Pressure	2009			2010			2011			2012			2013			2014			2015			2016			2017			2018			Total			10 year Total
	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High	
Success	3	5	13	2	13	17	7	5	10	10	5	15	7	7	15	5	6	15	3	4	18	5	10	18	7	5	15	8	8	22	57	68	158	283
Pass	1	2	11	2	10	14	4	3	6	4	4	11	3	3	11	3	4	13	3	3	15	4	8	17	5	4	13	5	6	16	34	47	127	208
Run	2	3	2	3	3	3	2	4	6	6	1	4	4	4	4	2	2	2	2	1	3	1	2	1	2	1	2	3	2	6	23	21	31	75
Failure	6	9	20	8	8	16	4	9	21	4	3	16	2	6	9	3	4	11	6	3	17	5	5	12	4	7	16	2	9	13	44	63	151	258
Pass	3	5	17	8	5	11	3	9	18	3	2	16	1	6	8	3	2	11	5	3	15	3	1	8	3	5	13	1	7	10	33	45	127	205
Run	3	4	3	3	3	5	1	3	3	1	1	4	4	4	4	2	2	2	1	2	2	2	4	4	1	2	3	1	2	3	11	18	24	53
Total	9	14	33	10	21	33	11	14	31	14	8	31	9	13	24	8	10	26	9	7	35	10	15	30	11	12	31	10	17	35	101	131	309	541
% Success	33%	36%	39%	20%	62%	52%	64%	36%	32%	71%	63%	48%	78%	54%	63%	63%	60%	58%	33%	57%	51%	50%	67%	60%	64%	42%	48%	80%	47%	63%	56%	52%	51%	52%
% of all attempts that are Passes	44%	50%	85%	100%	71%	76%	64%	86%	77%	50%	75%	87%	44%	69%	79%	75%	60%	92%	89%	86%	86%	70%	60%	83%	73%	75%	84%	60%	76%	74%	66%	70%	82%	76%
% of all attempt that are runs	56%	50%	15%	0%	29%	24%	36%	14%	23%	50%	25%	13%	56%	31%	21%	25%	40%	8%	11%	14%	14%	30%	40%	17%	27%	25%	16%	40%	24%	26%	34%	30%	18%	24%
% of Passes Successful	25%	29%	39%	20%	67%	56%	57%	25%	25%	57%	67%	41%	75%	33%	58%	50%	67%	54%	38%	50%	50%	57%	89%	68%	63%	44%	50%	83%	46%	62%	51%	51%	50%	50%
% of Runs Successful	40%	43%	40%	0%	50%	38%	75%	100%	57%	86%	50%	100%	80%	100%	80%	100%	50%	100%	0%	100%	60%	33%	33%	20%	67%	33%	40%	75%	50%	67%	68%	54%	56%	59%

Data was analyzed on a year-to-year basis as well as by pressure levels for 4th and 1 opportunities

Exhibit 11 – 4th and 1 by Pressure and Field Position Over Time

4th and 1 By Position on Field and Pressure	2009			2010			2011			2012			2013			2014			2015			2016			2017			2018			2018			Total			Grand Total	Trailing 9 Year Average			Change from Average			
	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High		Low	Medium	High	Overall			
Inside Own 40																																												
Attempts Inside Own 40	7	2	11	1	1	6	1	2	4	1	5	10	4	1	17	1	2	11	1	11	3	-	11	2	3	3	3	2	11	24	19	101	144	2.33	1.83	10.00								
Did not go for it	36	42	30	41	28	25	44	47	30	62	58	26	58	52	25	50	39	22	46	41	22	46	45	28	53	36	33	36	42	472	420	263	1,155	48.44	43.11	28.78								
Total instances inside own 40	43	44	41	42	29	31	45	49	34	63	63	36	62	53	42	51	41	33	33	47	42	33	49	45	39	55	39	42	39	34	33	436	439	364	1,299	50.78	45.00	38.78						
Attempts as a % of Total Instances By Pressure	16.28%	4.55%	26.83%	2.38%	3.45%	19.35%	2.22%	4.08%	11.76%	1.59%	7.94%	27.78%	6.45%	1.89%	40.48%	1.96%	4.88%	33.33%	2.13%	2.38%	33.33%	6.12%	0.00%	28.21%	3.84%	7.69%	5.88%	33.33%	4.84%	4.33%	27.75%	11.09%	4.60%	4.20%	27.19%	67.40%	40.14%	22.53%	40.68%					
All Attempts as a % of Total Instances	15.63%			7.84%			5.47%			9.88%			14.01%			11.20%			10.66%			10.53%			10.29%			15.09%			11.09%			10.73%										
Between own 40 and 49																																												
Attempts Inside between own 40 and 49	3	4	9	7	3	11	1	4	11	4	1	7	3	4	12	4	8	13	4	3	6	6	5	6	7	1	15	7	6	7	46	39	97	182	4.33	3.67	10.00							
Did not go for it	17	22	8	23	16	4	23	13	17	25	20	13	22	18	10	32	16	12	17	15	4	16	20	7	17	13	3	18	8	4	270	161	88	459	21.33	17.00	9.33							
Total instances between own 40 and 49	20	26	17	30	19	15	24	17	28	29	21	20	25	22	22	36	24	25	21	18	10	22	25	13	24	14	24	25	14	11	256	200	185	641	25.67	20.67	19.33							
Attempts as a % of Total Instances By Pressure	15.00%	15.38%	52.94%	23.33%	15.79%	73.33%	4.17%	23.53%	39.29%	13.79%	4.76%	35.00%	12.00%	18.18%	54.55%	11.11%	33.33%	52.00%	19.05%	16.67%	60.00%	27.27%	20.00%	46.15%	29.17%	7.14%	62.50%	28.00%	42.86%	63.64%	17.97%	19.50%	52.43%	28.39%	16.88%	17.74%	51.72%	65.85%	141.56%	23.03%	45.93%			
All Attempts as a % of Total Instances	25.40%			32.81%			23.19%			17.14%			27.54%			29.41%			26.53%			28.33%			37.10%			40.00%			28.39%			27.41%										
Between Opponent 41-50																																												
Attempts Inside between opponent 41-50	6	8	11	8	6	7	7	6	9	5	11	9	9	5	7	5	4	14	13	9	10	7	14	7	13	8	8	11	19	7	84	90	89	263	8.11	7.89	9.11							
Did not go for it	11	15	5	8	15	5	9	4	5	14	11	6	7	5	3	8	6	2	7	3	5	3	4	1	6	2	3	2	1	1	75	66	36	177	8.11	7.22	3.89							
Total instances between opponent 41-50	17	23	16	16	21	12	16	10	14	19	22	15	16	10	10	13	10	16	20	12	15	10	18	8	19	10	11	13	20	8	159	156	125	440	16.22	15.11	13.00							
Attempts as a % of Total Instances By Pressure	35.29%	34.78%	68.75%	50.00%	28.57%	58.33%	43.75%	60.00%	64.29%	26.32%	50.00%	60.00%	56.25%	50.00%	70.00%	38.46%	40.00%	87.50%	65.00%	75.00%	66.67%	70.00%	77.78%	87.50%	68.42%	80.00%	72.73%	84.62%	95.00%	87.50%	52.83%	57.63%	71.20%	59.77%	50.00%	52.21%	70.09%	69.23%	81.97%	24.85%	59.32%			
All Attempts as a % of Total Instances	44.64%			42.86%			55.00%			44.64%			58.33%			58.97%			68.09%			77.78%			72.50%			90.24%			59.77%			56.64%										
Between Opponent 31-40																																												
Attempts Inside between opponent 31-40	17	7	11	13	15	13	9	11	11	9	10	12	12	14	15	7	7	11	7	12	10	7	21	8	15	10	9	7	6	9	103	113	109	325	10.67	11.89	11.11							
Did not go for it	1	2	1	3	1	1	2	4	2	2	3	2	3	3	2	2	2	2	4	-	2	4	4	4	2	4	2	2	1	3	25	24	21	70	2.56	2.56	2.00							
Total instances between opponent 31-40	18	9	12	16	16	14	11	15	13	11	13	14	15	17	17	9	9	13	11	12	12	25	12	17	14	11	9	7	12	128	137	130	395	13.22	14.44	13.11								
Attempts as a % of Total Instances By Pressure	94.44%	77.78%	91.67%	81.25%	93.75%	92.86%	81.82%	73.33%	84.62%	81.82%	76.92%	85.71%	80.00%	82.35%	88.24%	77.78%	77.78%	84.62%	63.64%	100.00%	83.33%	63.64%	84.00%	66.67%	88.24%	71.43%	81.82%	77.78%	95.00%	80.47%	82.48%	83.85%	82.28%	83.85%	82.28%	82.31%	84.75%	-3.59%	4.14%	-11.50%	-4.83%			
All Attempts as a % of Total Instances	89.74%			89.13%			79.49%			81.58%			83.67%			80.65%			82.86%			75.00%			80.95%			78.57%			82.28%			82.56%										
Between Opponent 21-30																																												
Attempts Inside between opponent 21-30	13	8	11	8	10	9	10	4	9	10	7	7	3	8	10	5	8	8	8	4	4	4	4	8	15	6	6	7	7	6	83	66	78	227	8.44	6.56	8.00							
Did not go for it	7	5	2	2	7	4	3	8	2	7	6	1	5	7	6	2	4	1	3	4	4	3	6	3	3	6	1	4	1	2	39	54	26	119	3.89	5.89	2.67							
Total instances between opponent 21-30	20	13	13	10	17	13	12	11	17	13	8	8	15	16	7	12	9	11	8	8	7	10	11	18	12	7	4	8	8	122	120	104	346	12.33	12.44	10.67								
Attempts as a % of Total Instances By Pressure	65.00%	61.54%	84.62%	80.00%	58.82%	69.23%	76.92%	33.33%	81.82%	58.82%	53.85%	87.50%	37.50%	53.33%	62.50%	71.43%	66.67%	88.89%	72.73%	50.00%	50.00%	57.14%	40.00%	72.73%	83.33%	50.00%	85.71%	63.64%	87.50%	75.00%	68.03%	55.00%	75.00%	65.61%	65.61%	68.47%	52.68%	75.00%	-7.06%	66.10%	0.00%	14.15%		
All Attempts as a % of Total Instances	69.57%			67.50%			63.16%			53.85%			75.00%			59.26%			57.14%			72.97%			57.14%			74.07%			65.61%			64.89%										
Between Opponent 11-20																																												
Attempts Inside between opponent 11-20	6	11	10	8	5	6	4	5	7	5	3	7	8	5	8	2	5	1	7	2	4	4	9	7	3	8	5	6	12	9	53	65	64	182	5.22	5.89	6.11							
Did not go for it	7	5	3	4	4	9	9	3	3	8	10	1	9	6	3	2	3	4	2	6	1	6	6	8	4	6	5	3	2	6	54	54	61	148	5.67	5.44	4.11							
Total instances between opponent 11-20	13	16	13	12	9	15	13	8	10	13	8	17	11	11	4	8	5	9	8	5	10	15	15	7	14	10	9	14	107	116	107	330	10.89	11.33	10.22									
Attempts as a % of Total Instances By Pressure	46.15%	68.75%	76.92%	66.67%	55.56%	40.00%	30.77%	62.50%	70.00%	38.46%	23.08%	87.50%	47.06%	45.45%	72.73%	50.00%	62.50%	20.00%	77.78%	25.00%	80.00%	40.00%	60.00%	46.67%	42.86%	57.14%	50.00%	66.67%	85.71%	60.00%	49.53%	56.03%	59.81%	55.15%	47.96%	51.96%	59.78%	39.01%	64.96%	0.36%	33.85%			
All Attempts as a % of Total Instances	64.29%			52.78%			51.61%			44.12%			53.85%			47.06%			59.09%			50.00%			57.14%			71.05%			55.15%			53.08%										
Inside Opponent 10																																												
Attempts Inside inside opponent 10	32	11	18	18	14	19	9	8	16	15	13	13	11	17	18	18	13	16	17	13	7	13	20	11	11	16	16	13	23	17	157	148	151	456	16.00	13.89	14.89							
Did not go for it	9	8	9	8	10	11	12	14	4	10	15	2	14	9	8	6	5	4	7	8	8	6	4	6	9	7	2	2	3	79	86	61	226	8.56	9.33	6.44								
Total instances inside opponent 10	41	19	27	26	24	30	21	22	20	25	28	15	25	26	24	19	21	21	20	15	21	26	15	17	25	23	15	25	20	236	234	212	682	24.56	23.22	21.33								
Attempts as a % of Total Instances By Pressure	78.05%	57.89%	66.67%	63.23%	58.33%	63.33%	42.86%	36.36%	80.00%	60.00%	46.43%	86.67%	44.00%	65.38%	63.23%	75.00%	68.42%	76.19%	80.95%	65.00%	46.67%	61.90%	76.92%	73.33%	64.71%	64.00%	69.57%	86.67%	92.00%	85.00%	66.53%	63.25%	71.23%	66.86%	65.16%	59.81%	69.79%	33.01%	53.82%	21.79%	36.34%			
All Attempts as a % of Total Instances	70.11%			63.75%			52.38%			60.29%			59.74%			73.44%			66.07%			70.97%			66.15%			88.33%			66.86%			64.79%										
Cumulative Total																																												
Total Attempts "WENT FOR IT"	84	51	81	63	54	71	41	40	67	49	50	65	50	54	87	42	47	74	57	44	52	44	73	58	66	52	68	54	75	66	550	540	6											

Quarterback runs were further inspected (replays watched when possible) to clarify if the play was a designed run or a scramble on a pass play

Exhibit 13 – QB Runs on 2-Point Conversions

description	play_ty	Pass_PI	Run_pla	QB_Scramble	Designed_QB_Run
(Pass formation) TWO-POINT CONVERSION ATTEMPT. K.Orton pass to B.Marshall is incomplete. ATTEMPT FAILS	pass	1	0	0	0
TWO-POINT CONVERSION ATTEMPT. J.McCown pass to T.Benjamin is incomplete. ATTEMPT FAILS	pass	1	0	0	0
TWO-POINT CONVERSION ATTEMPT. J.Flacco pass to J.Forsett is incomplete. ATTEMPT FAILS	pass	1	0	0	0
TWO-POINT CONVERSION ATTEMPT. J.McCown pass to A.Hawkins is complete. ATTEMPT SUCCEEDS	pass	1	0	0	0
TWO-POINT CONVERSION ATTEMPT. J.Cutler pass to M.Forte is complete. ATTEMPT SUCCEEDS	pass	1	0	0	0
TWO-POINT CONVERSION ATTEMPT. L.Jones pass to A.Brown is incomplete. ATTEMPT FAILS	pass	1	0	0	0
TWO-POINT CONVERSION ATTEMPT. C.Kaepernick pass to A.Boldin is incomplete. ATTEMPT FAILS	pass	1	0	0	0
(Pass formation) TWO-POINT CONVERSION ATTEMPT. L.McCoy rushes right guard. ATTEMPT SUCCEEDS	run	0	1	0	0
TWO-POINT CONVERSION ATTEMPT. B.Hoyer pass to J.Grimes is incomplete. ATTEMPT FAILS	pass	1	0	0	0
TWO-POINT CONVERSION ATTEMPT. P.Rivers pass to L.Green is complete. ATTEMPT SUCCEEDS	pass	1	0	0	0
TWO-POINT CONVERSION ATTEMPT. P.Rivers pass to L.Green is complete. ATTEMPT SUCCEEDS	pass	1	0	0	0
TWO-POINT CONVERSION ATTEMPT. J.Flacco pass to N.Boyle is complete. ATTEMPT SUCCEEDS	pass	1	0	0	0
TWO-POINT CONVERSION ATTEMPT. N.Foles pass to J.Cook is complete. ATTEMPT SUCCEEDS	pass	1	0	0	0
(Pass formation) TWO-POINT CONVERSION ATTEMPT. T.Gurley rushes right guard. ATTEMPT SUCCEEDS	run	0	1	0	0
TWO-POINT CONVERSION ATTEMPT. T.Bridgewater rushes right end. ATTEMPT SUCCEEDS.	run	0	1	0	1
(Pass formation) TWO-POINT CONVERSION ATTEMPT. A.Rodgers pass to D.Adams is complete. ATTEMPT SUCCEEDS	no_play	N/A	N/A	0	0
(Pass formation) TWO-POINT CONVERSION ATTEMPT. M.Mariota pass to D.Walker is complete. ATTEMPT SUCCEEDS	pass	1	0	0	0
(Pass formation) TWO-POINT CONVERSION ATTEMPT. B.Roethlisberger pass to De.Williams is complete. ATTEMPT SUCCEEDS	pass	1	0	0	0
(Pass formation) TWO-POINT CONVERSION ATTEMPT. J.Winston pass to R.Shepard is incomplete. ATTEMPT FAILS	pass	1	0	0	0
TWO-POINT CONVERSION ATTEMPT. J.Langford rushes up the middle. ATTEMPT SUCCEEDS.	run	0	1	0	0
TWO-POINT CONVERSION ATTEMPT. A.Rodgers pass to D.Adams is incomplete. ATTEMPT FAILS	pass	1	0	0	0
TWO-POINT CONVERSION ATTEMPT. B.Bortles pass to A.Hurns is incomplete. ATTEMPT FAILS	pass	1	0	0	0
TWO-POINT CONVERSION ATTEMPT. J.Flacco pass to K.Aiken is incomplete. ATTEMPT FAILS.	pass	1	0	0	0
(Pass formation) TWO-POINT CONVERSION ATTEMPT. B.Roethlisberger pass to A.Brown is complete. ATTEMPT SUCCEEDS	pass	1	0	0	0
(Pass formation) TWO-POINT CONVERSION ATTEMPT. B.Osweiler rushes up the middle. ATTEMPT SUCCEEDS.	run	0	1	0	1

Highlighted above are 2 plays, one of which was determined to be a QB scramble that was wrongly classified as a run play, which was later converted to a pass, and the other a designed QB run (correctly called a run)

Many of the designed runs were QB draws, zone reads, or jumbo formations used on the goal line

There were roughly 20 plays with no video found, in which case, the original classification was kept

So What? The pass total could be higher than indicated, closer to 80% rather than 75% on 2-point conversions

