



3rd Down Percentage in Determining an NFL Team's Success

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Introduction

The NFL is behind the pack in the world of sports analytics. Baseball and basketball have way more games in a season than football, allowing for more data to be collected and analyzed. I wanted to make a modest attempt to break the norm and look at NFL data from the most recent five seasons which have been completed (2013-2017). More specifically, I have always heard that 3rd downs were the most crucial down in football and that a team's 3rd down percentage is vital to their success. I wanted to dig deeper and see if I could find out the truth to team's 3rd down percentages, all while analyzing the neglected sport of football.

I am making a hypothesis that a team's 3rd down percentage does indeed determine their success. I am not very confident with my hypothesis and am thinking that potentially this could have been true years ago in football and is not so true anymore. Indeed, there are many old ways of doing things that continue to be preached inside and outside of football. Further, I believe that five years of the most recent data will be sufficient in size for analyzing, most relevant in terms of age, and an easy number to manage.

Background Information

For this article I will be defining a team's success as the amount of wins they receive. This could be debated since sometimes teams make it further in the playoffs than teams with better records. But, when looking at data over five years, I determined the number of wins to be the best determinant of their overall success. Furthermore, I will be using data only from the regular season because that was readily available on the site I used and because it sets every team on a level playing field due to each team having 16 games each year. Most teams will not make the NFL playoffs, or will have less games in the playoffs than others, this would cause unequal data representation between teams if this was not omitted. In, addition, the preseason of the NFL is viewed very lightly and more of scrimmage-type games to many, so this will be omitted as well.

The term 3rd down percentage will be used a lot in this project and is defined as the percentage of the time a team gets a 1st down when on 3rd down. In other words, 3rd down conversions (total amount of times receiving a 1st down while on 3rd down) is divided by 3rd down attempts (total amount of 3rd down occurrences) to determine the 3rd down percentage. This is an important statistic to teams because if they are receiving 1st downs often when on 3rd down, this means they are extending their drive, thus increasing their chance to score.

Data Collection

I collected my data from <https://www.pro-football-reference.com> and was able to use several of their charts. I exported all the AFC Playoff Standings, NFC Playoff Standings, and Conversions tables from 2013-2017 into Excel. They had options of exporting it as a CSV file or else straight into Excel as an Excel doc. All their tables were convenient in the fact that they had their own sorting ability straight from the website. Therefore, I could click any of the columns and sort from highest to lowest or alphabetically.

2017 NFL Season

Player Stats ▼

Defensive Stats ▼

Weeks ▼

Leaders

Playoffs

Schedule

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Glossary

		Downs							Red Zone		
Rk	Tm	G	3DAtt	3DConv	3D%	4DAtt	4DConv	4D%	RZAtt	RZScore	RZPct
1	Buffalo Bills	16	241	101	41.9%	15	2	13.3%	44	23	52.3%
2	Philadelphia Eagles	16	230	96	41.7%	26	17	65.4%	55	36	65.5%
3	Minnesota Vikings	16	216	94	43.5%	7	1	14.3%	57	33	57.9%
4	Denver Broncos	16	241	94	39.0%	20	7	35.0%	48	19	39.6%
5	Carolina Panthers	16	222	93	41.9%	11	5	45.5%	52	28	53.8%
6	Pittsburgh Steelers	16	209	92	44.0%	8	3	37.5%	63	32	50.8%
7	San Francisco 49ers	16	234	91	38.9%	18	8	44.4%	51	24	47.1%
8	Los Angeles Rams	16	214	88	41.1%	12	5	41.7%	69	38	55.1%
9	Atlanta Falcons	16	197	88	44.7%	13	4	30.8%	54	27	50.0%
10	Dallas Cowboys	16	203	87	42.9%	19	10	52.6%	52	31	59.6%
11	Indianapolis Colts	16	228	87	38.2%	17	8	47.1%	40	16	40.0%
12	Tampa Bay Buccaneers	16	196	85	43.4%	8	4	50.0%	53	26	49.1%
13	Jacksonville Jaguars	16	228	85	37.3%	13	10	76.9%	50	32	64.0%
14	Los Angeles Chargers	16	209	84	40.2%	11	5	45.5%	47	22	46.8%
15	Green Bay Packers	16	211	83	39.3%	28	15	53.6%	42	26	61.9%
16	Arizona Cardinals	16	233	82	35.2%	16	7	43.8%	48	20	41.7%
17	Oakland Raiders	16	204	82	40.2%	24	8	33.3%	34	20	58.8%
18	New England Patriots	16	202	82	40.6%	13	8	61.5%	70	42	60.0%
19	New York Jets	16	228	81	35.5%	13	7	53.8%	33	18	54.5%
20	Detroit Lions	16	209	81	38.8%	9	1	11.1%	46	26	56.5%
21	Seattle Seahawks	16	212	79	37.3%	9	5	55.6%	45	25	55.6%
22	Kansas City Chiefs	16	199	78	39.2%	10	3	30.0%	50	21	42.0%
23	Baltimore Ravens	16	223	76	34.1%	16	10	62.5%	52	30	57.7%
24	Houston Texans	16	209	76	36.4%	10	5	50.0%	42	22	52.4%
25	New York Giants	16	227	74	32.6%	21	8	38.1%	39	19	48.7%
26	Cleveland Browns	16	216	73	33.8%	23	12	52.2%	39	19	48.7%
27	New Orleans Saints	16	194	73	37.6%	15	12	80.0%	55	32	58.2%
28	Tennessee Titans	16	202	71	35.1%	10	5	50.0%	40	21	52.5%
29	Chicago Bears	16	205	71	34.6%	18	7	38.9%	33	20	60.6%
30	Cincinnati Bengals	16	199	67	33.7%	12	5	41.7%	43	24	55.8%
31	Washington Redskins	16	204	66	32.4%	16	9	56.3%	46	25	54.3%
32	Miami Dolphins	16	202	64	31.7%	24	7	29.2%	38	20	52.6%

Figure 1 – 2017 Conversions Table from Website

AFC Playoff Standings [Share & more ▼](#) [Glossary](#)

Tm	W	L	T	Position	Reason
New England Patriots (1)	13	3	0	East Champion	head-to-head record
Pittsburgh Steelers (2)	13	3	0	North Champion	
Jacksonville Jaguars (3)	10	6	0	South Champion	conference win percentage
Kansas City Chiefs (4)	10	6	0	West Champion	
Tennessee Titans (5)	9	7	0	Wild Card #1	conference win percentage
Buffalo Bills (6)	9	7	0	Wild Card #2	strength of victory
Baltimore Ravens	9	7	0		conference win percentage
Los Angeles Chargers	9	7	0		
Cincinnati Bengals	7	9	0		
Oakland Raiders	6	10	0		head-to-head record
Miami Dolphins	6	10	0		
Denver Broncos	5	11	0		head-to-head record
New York Jets	5	11	0		
Indianapolis Colts	4	12	0		head-to-head record
Houston Texans	4	12	0		
Cleveland Browns	0	16	0		

Figure 2 – 2017 AFC Standings Table from Website

NFC Playoff Standings [Share & more ▼](#) [Glossary](#)

Tm	W	L	T	Position	Reason
Philadelphia Eagles (1)	13	3	0	East Champion	win percentage in common games
Minnesota Vikings (2)	13	3	0	North Champion	
Los Angeles Rams (3)	11	5	0	West Champion	head-to-head record
New Orleans Saints (4)	11	5	0	South Champion	head-to-head record
Carolina Panthers (5)	11	5	0	Wild Card #1	
Atlanta Falcons (6)	10	6	0	Wild Card #2	
Detroit Lions	9	7	0		conference win percentage
Seattle Seahawks	9	7	0		head-to-head record
Dallas Cowboys	9	7	0		
Arizona Cardinals	8	8	0		
Green Bay Packers	7	9	0		win percentage in common games
Washington Redskins	7	9	0		
San Francisco 49ers	6	10	0		
Tampa Bay Buccaneers	5	11	0		head-to-head record
Chicago Bears	5	11	0		
New York Giants	3	13	0		

Figure 3 – 2017 NFC Standings Table from Website

Data Cleaning/Merging

Once I had all 15 individual Excel spreadsheets, I started by copy and pasting either the AFC Playoff Standings into the NFC Playoff Standings or vice versa. I pasted them into the right order from the amount of wins the team had. I had little cleaning to do of the data, as it was pretty much clean from the initial collection. I deleted the columns of Position and Reason in the Standings tables since they were irrelevant to what I was doing. I deleted the Rk, G, 4DAtt, 4DConv, 4D%, RZAtt, RZConv, and RZPct columns of the Conversions tables since I was only looking at 3rd down statistics. Next, I had to copy and paste the data as values since usually the formatting was off. I added a

Conference column in case I wanted to use this for later statistics. Finally, I deleted the trailing (1)-(6) at the end of the top six ranked team's name to clean up their names. Once I had this completed for all five years and for each table, I merged them into one spreadsheet by copy and pasting them into their individual tabs.

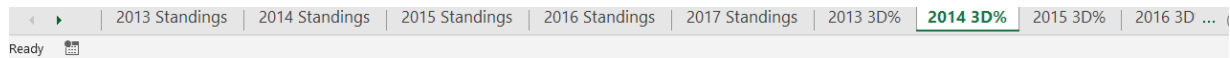


Figure 4 - Excel Tabs After Merge

Once I had all the data cleaned and into the same Excel spreadsheet, I made a new tab where I started to combine all the years together. In other words, 2013-2017 wins, losses, ties, 3rd down attempts, and 3rd down conversions were all added up. On the contrary, 3rd down percentage was averaged because it would not make sense to sum up percentages and leave us with percentages over 100. To make things easier for myself, I first sorted every tab alphabetically by team name, so I could make use of relative formulas in Excel. This would have been a simple process of copying formulas over and across the entire table had it not been for two NFL teams that had name changes between the five-year period (which thus changed the order of the teams alphabetically). Specifically, the current Los Angeles Chargers and Los Angeles Rams were formerly the San Diego Chargers and the St. Louis Rams. I would have never thought about this until I double checked the summation of wins and the New England Patriots had way less than I anticipated. Indeed, after double checking my work I found out the reason and ended up fixing my formulas which took a little bit of manual labor on my part. The final step was to order my table from highest to lowest with a simple sort.

Team	3DAtt	3DConv	3D%
New Orleans Saints	1056	479	45.36%
Atlanta Falcons	1019	452	44.36%
Los Angeles Chargers	1061	464	43.73%
New England Patriots	1086	455	41.90%
Green Bay Packers	1042	433	41.55%
Carolina Panthers	1078	446	41.37%
Pittsburgh Steelers	1028	425	41.34%
Dallas Cowboys	964	391	40.56%
Philadelphia Eagles	1134	458	40.39%
Seattle Seahawks	1048	423	40.36%
Detroit Lions	1051	420	39.96%
Indianapolis Colts	1095	437	39.91%
Denver Broncos	1102	437	39.66%
Arizona Cardinals	1079	426	39.48%
Tampa Bay Buccaneers	1036	408	39.38%
Minnesota Vikings	1053	411	39.03%
Chicago Bears	1013	395	38.99%
Cincinnati Bengals	1046	406	38.81%
Washington Redskins	1051	407	38.73%
Buffalo Bills	1151	440	38.23%
New York Jets	1132	431	38.07%
Kansas City Chiefs	1025	389	37.95%
Houston Texans	1157	433	37.42%
Tennessee Titans	1043	388	37.20%
Oakland Raiders	1101	409	37.15%
Baltimore Ravens	1140	423	37.11%
New York Giants	1109	404	36.43%
San Francisco 49ers	1093	397	36.32%
Cleveland Browns	1099	389	35.40%
Miami Dolphins	1012	352	34.78%
Jacksonville Jaguars	1095	374	34.16%
Los Angeles Rams	1032	348	33.72%

Figure 5 - Combined 3rd Down Statistics

Team	TotWins	TotLose	TotTies	AvWins	AvLosses	AvTies	Conference
New England Patriots	63	17	0	12.6	3.4	0	AFC
Seattle Seahawks	54	25	1	10.8	5	0.2	NFC
Pittsburgh Steelers	53	27	0	10.6	5.4	0	AFC
Kansas City Chiefs	53	27	0	10.6	5.4	0	AFC
Carolina Panthers	51	28	1	10.2	5.6	0.2	NFC
Denver Broncos	51	29	0	10.2	5.8	0	AFC
Arizona Cardinals	49	30	1	9.8	6	0.2	NFC
Green Bay Packers	47	32	1	9.4	6.4	0.2	NFC
Philadelphia Eagles	47	33	0	9.4	6.6	0	NFC
Cincinnati Bengals	46	32	2	9.2	6.4	0.4	AFC
Dallas Cowboys	46	34	0	9.2	6.8	0	NFC
Minnesota Vikings	44	35	1	8.8	7	0.2	NFC
Detroit Lions	43	37	0	8.6	7.4	0	NFC
New Orleans Saints	43	37	0	8.6	7.4	0	NFC
Indianapolis Colts	42	38	0	8.4	7.6	0	AFC
Baltimore Ravens	40	40	0	8	8	0	AFC
Buffalo Bills	39	41	0	7.8	8.2	0	AFC
Atlanta Falcons	39	41	0	7.8	8.2	0	NFC
Miami Dolphins	38	42	0	7.6	8.4	0	AFC
Los Angeles Chargers	36	44	0	7.2	8.8	0	AFC
Los Angeles Rams	35	45	0	7	9	0	NFC
San Francisco 49ers	33	47	0	6.6	9.4	0	NFC
New York Giants	33	47	0	6.6	9.4	0	NFC
Houston Texans	33	47	0	6.6	9.4	0	AFC
Oakland Raiders	32	48	0	6.4	9.6	0	AFC
New York Jets	32	48	0	6.4	9.6	0	AFC
Washington Redskins	31	48	1	6.2	9.6	0.2	NFC
Tennessee Titans	30	50	0	6	10	0	AFC
Chicago Bears	27	53	0	5.4	10.6	0	NFC
Tampa Bay Buccaneers	26	54	0	5.2	10.8	0	NFC
Jacksonville Jaguars	25	55	0	5	11	0	AFC
Cleveland Browns	15	65	0	3	13	0	AFC

Figure 6 - Combined Standings Statistics

The next step was to order my data, so I would have a rank for every team for their 3rd down percentage and for their record. From Figure 6 it is evident that some teams ended up with the same records after combing five years of data. My solution to this was to look at the schedules of the teams who were in a tie, and whoever beat the other the most between the five years would be ahead. For example, between the Chiefs and Steelers, the Steelers won more games against the Chiefs than vice versa. Next, the Lions won more against the Saints. But, between the Falcons and Bills there was another tie, so the tie breaker was to choose who won by the most points between the five years which was the Bills. The Raiders won more against the Jets. Lastly, the three-way tie was a little trickier, but the 49ers beat both teams, the giants beat the Texans, and the Texans did not beat either. Once I resolved the ties, I copy and pasted the sorted order of each into a tab, and then ranked them. Finally, I just had to sort them alphabetically so that the team names would match up.

Rank	Standings	Rank	3D%
7	Arizona Cardinals	14	Arizona Cardinals
18	Atlanta Falcons	2	Atlanta Falcons
16	Baltimore Ravens	26	Baltimore Ravens
17	Buffalo Bills	20	Buffalo Bills
5	Carolina Panthers	6	Carolina Panthers
29	Chicago Bears	17	Chicago Bears
10	Cincinnati Bengals	18	Cincinnati Bengals
32	Cleveland Browns	29	Cleveland Browns
11	Dallas Cowboys	8	Dallas Cowboys
6	Denver Broncos	13	Denver Broncos
13	Detroit Lions	11	Detroit Lions
8	Green Bay Packers	5	Green Bay Packers
24	Houston Texans	23	Houston Texans
15	Indianapolis Colts	12	Indianapolis Colts
31	Jacksonville Jaguars	31	Jacksonville Jaguars
4	Kansas City Chiefs	22	Kansas City Chiefs
20	Los Angeles Chargers	3	Los Angeles Chargers
21	Los Angeles Rams	32	Los Angeles Rams
19	Miami Dolphins	30	Miami Dolphins
12	Minnesota Vikings	16	Minnesota Vikings
1	New England Patriots	4	New England Patriots
14	New Orleans Saints	1	New Orleans Saints
23	New York Giants	27	New York Giants
26	New York Jets	21	New York Jets
25	Oakland Raiders	25	Oakland Raiders
9	Philadelphia Eagles	9	Philadelphia Eagles
3	Pittsburgh Steelers	7	Pittsburgh Steelers
22	San Francisco 49ers	28	San Francisco 49ers
2	Seattle Seahawks	10	Seattle Seahawks
30	Tampa Bay Buccaneers	15	Tampa Bay Buccaneers
28	Tennessee Titans	24	Tennessee Titans
27	Washington Redskins	19	Washington Redskins

Figure 7 - Final Rankings

Data Analysis

The first step of my analysis was to determine if this data was normal or if it had lots of variance. I tested the mean, median, mode, standard deviation, skew, and kurtosis of both the standings and 3rd down statistics.

Mean	39.875
Median	39.5
Mode	33
Std Dev	10.3355
Skew	-0.0854
Kurtosis	-0.02507

Figure 8 - Standings Statistics

Mean	0.390255	39.03%
Median	0.390122	39.01%
Mode	None	
Std Dev	0.027687	
Skew	0.215408	
Kurtosis	0.07634	

Figure 9 - 3rd Down Percentage Statistics

The data appears to be normal with similar mean, median, and modes, as well as small variance. My next step was to determine if 3rd down percentage does indeed determine a team's success. In other words, how similar is the ranking from the standings data compared to the ranking of the 3rd down percentage data. From a quick glance (Figure 7) it appears that the ranks are relatively close to one another, but there are four teams which have a difference in rank of 15 or more including: Atlanta Falcons (16 rank difference), Kansas City Chiefs (18 rank difference), Los Angeles Charges (17 rank difference), and the Tampa Bay Buccaneers (15 rank difference). Therefore, I did not know if this would indeed throw off the test or not.

To determine the strength of the correlation between the standings ranking and the 3rd down percentage ranking, I tested the Pearson product-moment correlation. The Pearson correlation is looking for a linear relationship via parametric data. The Pearson correlation gave me a correlation of 0.52 which I'm defining as moderate. In summary, the null hypothesis would be that there is not a significant relationship between 3rd down percentage and a team's standings. With 95% confidence I am not able to reject this leading to the idea that there indeed is a relationship between these two.

Standings	3D%			
63	41.90%		Pearson	
54	40.36%	Correlation	0.51777222	Moderate Correlation
53	41.34%	N	32	
53	37.95%	t	3.314896406	
51	41.37%	p-value	0.002404106	<0.05
51	39.66%			
49	39.48%			
47	41.55%			
47	40.39%			
46	38.81%			
46	40.56%			
44	39.03%			
43	39.96%			
43	45.36%			
42	39.91%			
40	37.11%			
39	38.23%			
39	44.36%			
38	34.78%			
36	43.73%			
35	33.72%			
33	36.32%			
33	36.43%			
33	37.42%			
32	37.15%			
32	38.07%			
31	38.73%			
30	37.20%			
27	38.99%			
26	39.38%			
25	34.16%			
15	35.40%			

Figure 10 - Pearson Correlation

Conclusion

In conclusion, the Pearson correlation was used to determine if there was a correlation at all, and if so, how strong. It appears there is a moderate positive correlation that is linear. Therefore, it looks like 3rd down percentage does indeed determine a team's success to some extent. Although we saw some outliers like the Atlanta Falcons, Kansas City Chiefs, Los Angeles Chargers, and Tampa Bay Buccaneers, it looks like the rest of the teams were close enough to their ranks to give us a p-value less than 0.05.

A future application of this study could be to extrapolate those results and see if other years prior to 2013 would give me similar results. For instance, I could take years 2008-2012 and replicate the same study to see if similar results are found. Lastly, this study opens the door to future endeavors in analyzing football, with hopes in catching up to both baseball and basketball.