Date: July 7, 2020

To: David McDonald: Director of Research & Development for the Baltimore Ravens

From: Alexander Carcamo

RE: What is the main reason for disparity in a player's vertical leap?

As you already know, the NFL combine is an event where players showcase their abilities with maximum effort in hopes that their performance will raise their draft stock. One of the more important events in the NFL combine is the vertical leap event. Here a couple inches or reach can make or break your NFL potential. There are many variables that can influence a player's vertical leap abilities, and today we will take a look at some of the most important ones that you may want to consider. The goal of this was to provide an accurate look at how we can improve a player's vertical leap once they are in the league. If we can figure out which variable has the best correlation to their vertical leap, we know what area the player should focus on.

We will be looking at multiple variables to see which one may have the largest influence on the player's vertical leap. I predicted that height will have the highest correlation to vertical leap. This did not end up being the case, because the tight end position ended up being the one most closely associated with vertical leap. The dataset that was used for these findings is data that displays each player's combine results for all events that they participate in[1]. It contains data for every player that has participated from the years 1987-2018. The 4 variables that I used for the regression model are year, position, height, and weight. Year was simply the year that the player participated in the NFL combine, height was the player's height measured in inches, and weight was their weight in pounds. For position I only included 5 positions that I felt like were important to have a high vertical leap ability. This is because not every player may need to have a high vertical jump. Only certain offensive players have a chance to catch the ball, and only certain defensive players will have a chance at intercepting the ball. For example, NFL quarterbacks will rarely ever jump. They are more focused on performing well on events that will show off their accuracy and arm strength. The 5 positions included were running back, tight end, wide receiver, free safety, and strong safety. I felt as if these 5 positions

Table 1: Quantitative Summary

	Freq	Min	Max	Med.	Mean	SD
Year	3017	2005	2018	2002	2002	9.42
Height (in)	3017	64.90	80.0	72.38	72.51	2.53
Weight (lbs)	3017	144.0	336.0	207.0	210.7	24.17
Vertical Leap (in)	3017	22.5	46.0	34.0	33.93	3.34

[1] https://www.kaggle.com/ronaldjgrafjr/nfl-draft-outcomes/version/1

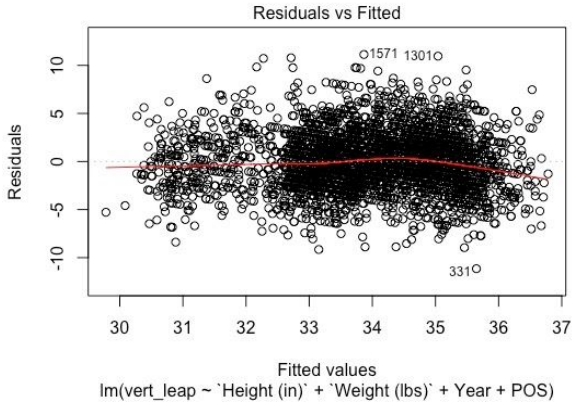
jump the most in game and they train for a good score on their vertical leap. I put these 4 variables against the vertical leap variable to see which one had the highest relation associated with it. The vertical leap variable is the measure recorded when they participated in the vertical leap event measured in inches. Additionally there are players that may even opt out of the vertical leap event at the combine. They may feel like it is not an essential event to participate in. For these players with missing vertical leap values, I removed them from consideration because they can't be considered without a vertical leap value. The regression model for this test is Vertical Leap can be written as *vertical leap = b(height) + b(weight) + b(year) + b(position) + error.*

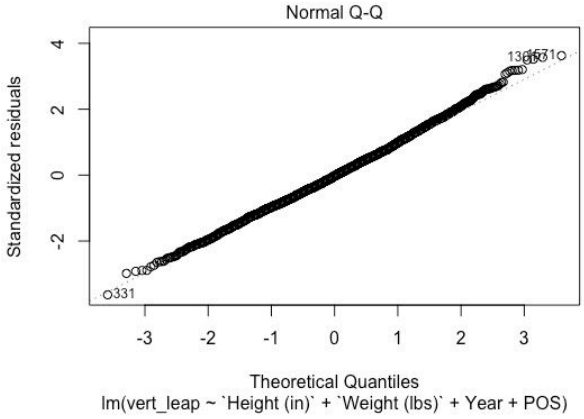
Table 2: Categorical Summary

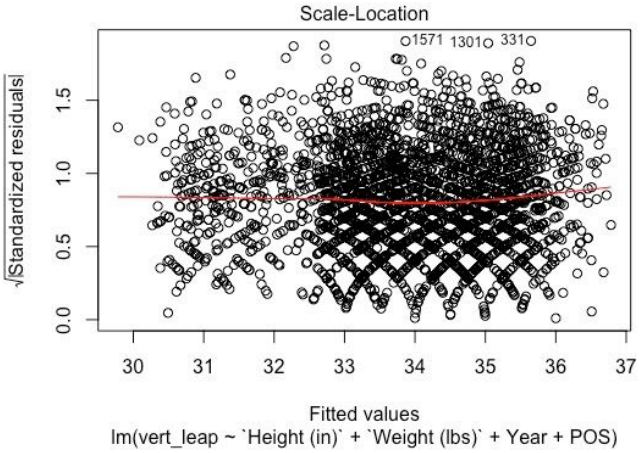
	Freq.	Percent
Position		
Wide Receiver	1128	37.39%
Running Back	777	25.75%
Free Safety	339	11.24%
Strong Safety	284	9.41%
Tight End	489	16.21%
Total	3017	100%

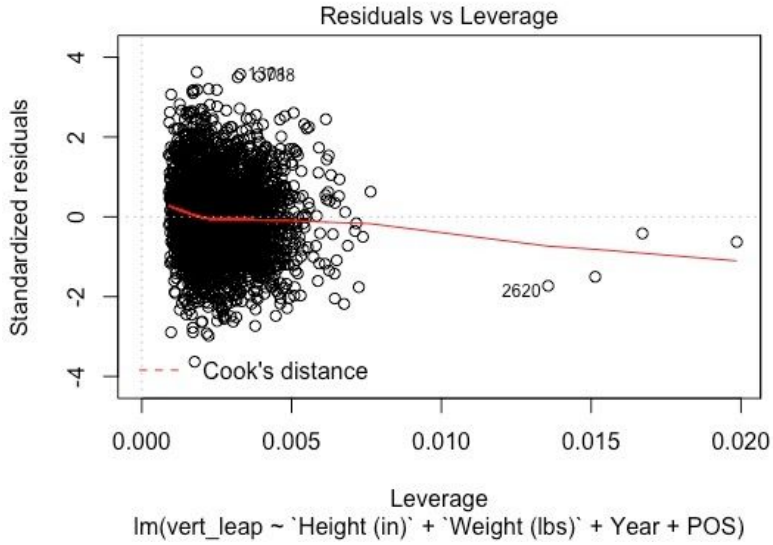
After conducting a multiple linear regression model, I found that almost every variable has a statistically significant relationship with vertical leap. The only exception being the strong safety position. This conclusion was drawn after all variables besides strong safety had a p-value smaller than our alpha of 0.1. The corresponding coefficients are described as follows. For every 1 inch change in height we can expect to see a change of 1.391e-01 in a player's vertical leap. For every 1 pound change in weight we can expect to see a change of -1.504e-02 in a player's vertical leap. For every year that passes, we can expect to see a change of 9.613e-02 in a player's vertical leap. Playing the running position will yield a -6.507e-01 change, wide receivers have a -7.236e-01 change, strong safeties have a -1.283e-01 change, and tight ends have a -2.750e+00 change. As mentioned before, the tight end position has the highest estimate coefficient. The r-squared statistic of 0.15 means only 15% of the variation in vertical leap is explained within these variables.

With the few variables chosen for this model we were able to see some patterns in our data. The position that a player chooses can have an influence on their vertical leap. We only looked at 5 different positions, and of course the other variables will have variation within them. The next step would be to use these results and decide where to work to increase a player's vertical height, or to conduct another multiple linear regression using other variables.


Residuals vs Fitted
Residuals
Fitted values
lm(vert_leap ~ `Height (in)` + `Weight (lbs)` + Year + POS)


Normal Q-Q
Standardized residuals
Theoretical Quantiles
lm(vert_leap ~ `Height (in)` + `Weight (lbs)` + Year + POS)


Scale-Location
√|Standardized residuals|
Fitted values
lm(vert_leap ~ `Height (in)` + `Weight (lbs)` + Year + POS)


Residuals vs Leverage
Standardized residuals
Cook's distance
Leverage
lm(vert_leap ~ `Height (in)` + `Weight (lbs)` + Year + POS)

	Dependent variable:
	vert_leap
`Height (in)`	0.139^{***}
	(0.038)
`Weight (lbs)`	-0.015^{***}
	(0.005)
Year	0.096^{***}
	(0.006)
POSRB	-0.651^{***}
	(0.225)
POSSS	-0.128
	(0.250)
POSTE	-2.750^{***}
	(0.298)
POSWR	-0.724^{***}
	(0.192)
Constant	-164.572^{***}
	(12.817)
Observations	3,017
R^2	0.156
Adjusted R^2	0.154
Residual Std. Error	3.072 (df = 3009)
F Statistic	79.296^{***} (df = 7; 3009)
Note:	*p<0.1; **p<0.05; ***p<0.01