PREDICTING PASSER RATING

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EXECUTIVE SUMMARY

- PROBLEM: What statistics have the largest impact on passer rating? This analysis is beneficial because it allows players, fans, and analysts to predict how a quarterback's performance will impact their passer rating and whether that is relevant to their success at their position.
- DATA SOURCE: We searched each Individual player's career statistics on Pro Football Reference for our analysis.
- METHODS: Multi-linear regression model, collinearity, and residual plots
- MEASURES: Variables, p-values of variables, multicollinearity/correlation
- CONCLUSIONS: The most significant variable was Career Completion Percentage, with a positive relationship. The least significant was Average Rushing Yards/Game, with a negative relationship. Career Yards per Attempt, Career Touchdown Percentage and Career Interception Percentage were also significant in predicting Passer Rating.

PROBLEM STATEMENT

- STATEMENT: How do various statistics affect a quarterback's passer rating?
- FURTHER QUESTIONS:
  - Is Passer Rating a good indicator of a quarterback's ability to play their position effectively?
  - Is there any correlation between rushing yards and passer rating?
  - Which statistic has the most influence on passer rating?
  - Which statistic has the least influence on passer rating?

PROBLEM STATEMENT- HOW ARE WE GOING TO SOLVE IT?

- DEPENDENT VARIABLE: Quarterback's passer rating
- INDEPENDENT VARIABLES:
  - Career Completion Percentage
  - Career Yards per Attempt
  - Career Touchdown Percentage
  - Career Interception Percentage
  - Career Sack Percentage
  - Average Pass Attempts per Game
  - Average Rushing Yards per Game

STRATEGY: Develop a multi-variable regression model in order to estimate the passer rating of a quarterback throughout their career.

OUR ASSUMPTIONS:

- All quarterbacks played in the NFL for one full season or more
- We used a significant level of 0.05 as our alpha
- Data is taken each from individual quarterback's career statistics on Pro Football Reference

METHODOLOGY: INDEPENDENT VARIABLE DEFINITIONS

- *CAREER COMPLETION PERCENTAGE:* Career completion percentage is the percent of time the quarterback has attempted to throw the ball and the result was a completed a pass
- *CAREER YARDS PER ATTEMPT:* Career yards per attempt is the average number of yards the quarterback gained per pass attempt
- *CAREER TOUCHDOWN PERCENTAGE:* Career touchdown percentage is the percent of time the quarterback has attempted a pass, and the result was a touchdown
- *CAREER INTERCEPTION PERCENTAGE:* Career interception percentage is the percent of time the quarterback had attempted a pass, and the result of the throw was an interception
- *CAREER SACK PERCENTAGE:* Career sack percentage is the percent of time the quarterback dropped back to attempt a pass and was tackled behind the line of scrimmage
- *AVERAGE PASS ATTEMPTS PER GAME:* Average pass attempts per game is the average number of passes they attempted per game throughout their career
- *AVERAGE RUSHING YARDS PER GAME: Average rushing yards per game is the average number of yards each Quarterback ran for each game*

METHODOLOGY- COLLECTED DATA

- We chose 50 quarterbacks to use for the analysis (past and present)
- Each quarterback's name was searched, and their statistics were entered into a spreadsheet under the appropriate section
- The seven independent variables we selected are directly related to a quarterback's success

- Dependent Variable: Passer Rating
  - Passer rating is a score given to quarterbacks that is supposed to gauge how well they are doing at throwing the ball which is there job on the football field. The maximum rating is 158.3. Anything between 85-95 is considered average while any score above 100 is deemed as elite.

OUR DATA & HYPOTHESIS

Hypothesis

- Alpha=0.05
- Ho= The coefficient of the independent variables equal zero and therefore do not have any impact on a quarterback's passer rating
- Ha= The coefficients of the independent variables do not equal zero and therefore have an impact on a quarterback's passer rating

Quarterback	Career Completion %	Career Yds/Att	Career TD %	Career Int %	Career Sack %	Career Pass Att./Game	Avg rushing yards per game	Passer Rating (X)
Tua Tagovailoa	66.9	7.7	4.81	2.26	5.49	30.9	7.19	96.5
Jared Goff	67.3	7.41	4.5	2	5.3	35.1	4.23	95.7
Dak Prescott	67	7.6	5.2	1.9	5.7	34	16.5	99
Josh Allen	63.2	7.2	5.3	2.5	5.3	33.5	38.4	92
Brock Purdy	68.7	9.2	7.2	2.4	6	24.6	6.3	111.7
Patrick Mahomes	66.5	7.9	6.1	1.8	4	37.4	20.2	103.2
Jordan Love	63.7	7.2	5.3	2.1	4.7	24.5	10.1	94.1
C.J. Stroud	63.9	8.2	4.6	1	7.1	33.3	11.1	100.7
Baker Mayfield	61.9	7.2	4.6	2.6	6.9	31.7	9.2	88.2
Trevor Lawrence	63.8	6.7	3.3	2.2	5.1	35	19.3	85
Matthew Stafford	63.2	7.3	4.7	2.4	5.8	37.1	6.4	90.8
Sam Howell	63.2	6.5	3.5	3.5	9.7	35.1	16.6	78.9
Derek Carr	64.9	7.1	4.4	1.9	5.1	34.6	5.6	92.5
Jalen Hurts	63.4	7.5	4.2	2.2	6.7	25.5	40.4	91
Lamar Jackson	64.5	7.5	5.9	2.1	7.4	24.6	61.1	98
Geno Smith	63.3	7.1	4	2.7	7.6	27	15.9	86.5
Gardner Minshew	62.6	7	4.1	1.7	6	29	12.7	90
Justin Herbet	66.6	7.1	4.7	1.7	5.1	39.1	14.7	95.8
Russel Wilson	64.7	7.7	5.9	1.9	8.5	30.1	28.2	99.8
Bryce Young	59.8	5.5	2.1	1.9	10.5	32.9	15.8	73.9
Desmond Ridder	64	7	2.8	2.4	7.4	26.5	13.5	83.9
Justin Fields	60.3	7	4.2	3.1	12.4	24	55.5	82.6
Kirk Cousins	66.9	7.6	5.2	2.1	5.5	34.5	6.4	98.1
Joe Burrow	68	7.4	5.1	2	7.2	36.4	11.6	98.2
Zach Wilson	57	6.3	2.3	2.5	10.2	29.2	14.6	73.1
Aaron Rodgers	65.3	7.7	6.2	1.4	6.5	33.2	15	103.4
Jimmy Garopollo	67.4	8.2	5	2.7	6.7	23.4	3.3	97.8
Mac Jones	66.1	6.8	3.5	2.8	6	31.1	7.8	85.5
Kenny Pickett	62.6	6.3	1.8	1.8	6.6	28.5	11.6	79
Kyler Murray	66.6	7	4.2	2.1	6.2	34.4	37.7	92
Ryan Tannehill	64.2	7.3	4.5	2.4	8	30.7	13.6	91
Deshaun Watson	66.5	8	5.6	2.2	9.2	31.7	30.2	100.3
Daniel Jones	64.3	6.6	5.6	2.2	9.2	31.7	30.2	92.7
Tom Brady	64.3	7.4	5.4	1.8	4.5	36	3.4	97
Peyton Manning	65.3	7.7	5.7	2.7	3.1	35.3	2.5	96.3
Eli Manning	60.3	7	4.5	3	4.8	34.4	2.4	84
Phillip Rivers	64	7.8	5.2	2.6	5.4	33.3	2.5	94.4
Mike Vick	56.2	7	4.1	2.7	8.9	22.5	42.7	80.5
Matt Ryan	65.6	7.4	4.5	2.2	5.5	36.2	6.6	93.4
Ben Roethlesberge	64.4	7.6	5	2.5		33.4	5.2	93.7
Tim Tebow	47.9	6.7	4.7	2.5	10.2	15.3	38.6	75.2
Jay Cutler	62	7.1	4.6	3.3	6.1	32.2	11	84.9
Drew Brees	67.7	7.6	5.4	2.3	3.8	36.8	2.6	98.6
Carson Palmer	62.5	7.3	4.7	3	5.1	34.7	2.6	87.8
Carson Wentz	62.7	6.7	4.6	2	6.7	34.8	14.9	89.2
Joe Flacco	61.6	6.8	3.8	2.4	5.6	34.6	4.6	84.4
Cam Newton	59.9	7.2	3.5	2.7	6.9	30.2	38	82.3
Tony Romo	65.3	7.9	5.7	2.7	5.4	27.8	4	97.2
Andrew Luck	60.8	7.2	6.1	2.5	5	38.3	18.5	92.7
Andy Dalton	62.5	7.1	4.5	2.6	6	32.27	8.7	87.1

MULTICOLLINEARITY/CORRELATION MATRIX

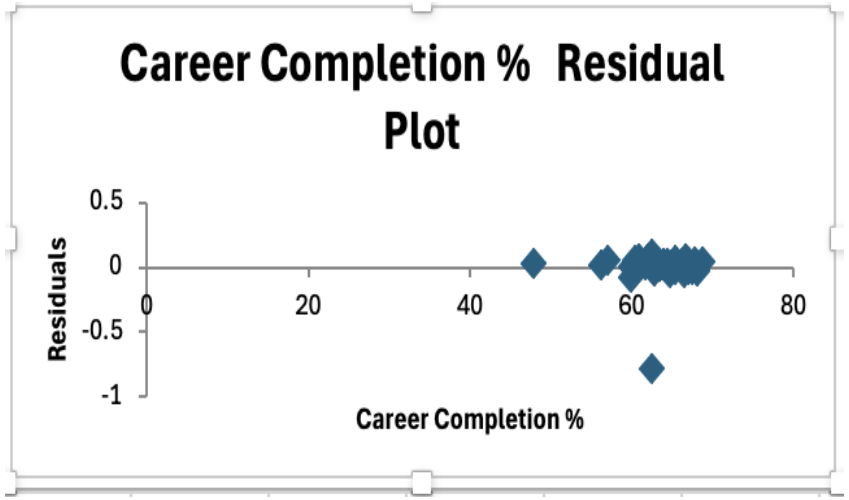
	Career Completion %	*Career Yds/Att*	*Career TD %*	*Career Int %*	*Career Sack %*	*Career Pass Att./Game*	*Avg rushing yards per game*
Career Completion %	1						
Career Yds/Att	0.544208163	1					
Career TD %	0.389707374	0.765871958	1				
Career Int %	-0.285518631	-0.140933638	-0.124803914	1			
Career Sack %	0.002842035	0.060237298	0.02664056	0.065309315	1		
Career Pass Att./Game	0.468519369	-0.028915885	0.091435762	-0.200172593	0.024627912	1	
Avg rushing yards per game	-0.354968143	-0.166907994	-0.012211688	0.028756193	-0.079805434	-0.452315232	1

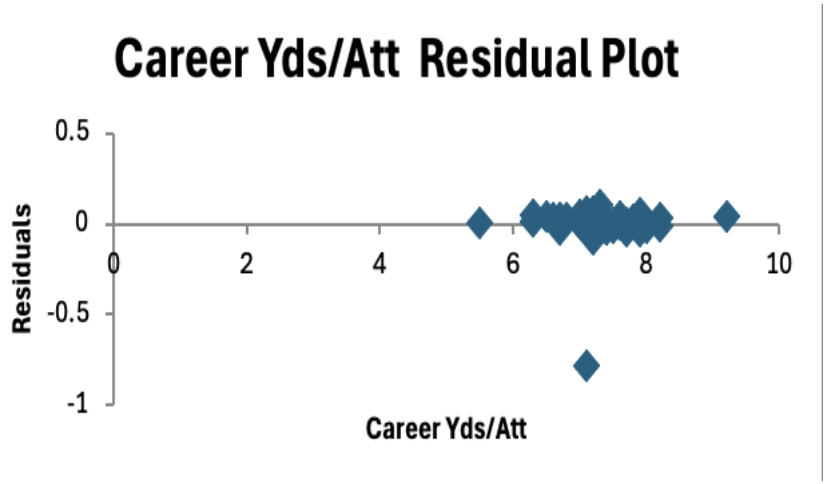
REMOVED HIGH P-VALUES

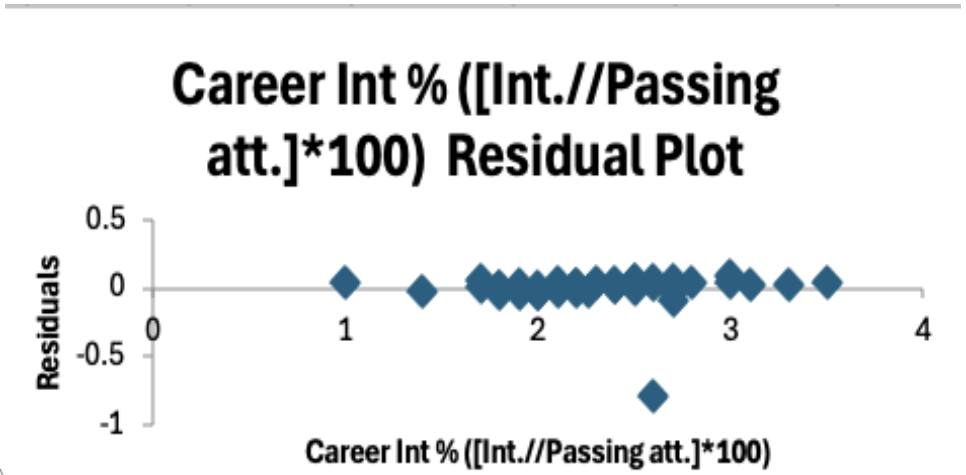
	Coefficients	Standard Erro	t Stat	P-value
Intercept	2.128609	0.462926	4.598163	3.88E-05
Career Completion %	0.834604	0.007834	106.5365	9.73E-53
Career Yds/Att	4.157664	0.062443	66.58371	3.24E-44
Career TD % ([TDs/Passing att.]*100)	3.340418	0.028753	116.178	2.59E-54
Career Int % ([Int.//Passing att.]*100)	-4.19082	0.040738	-102.873	4.21E-52
Career Sack % ([Sck/Passing att.]*100)	0.00029	0.000569	0.509516	0.613057
Career Pass Att./Game	-0.00205	0.005308	-0.3864	0.701155
Avg rushing yards per game	0.000266	0.001534	0.173639	0.862983

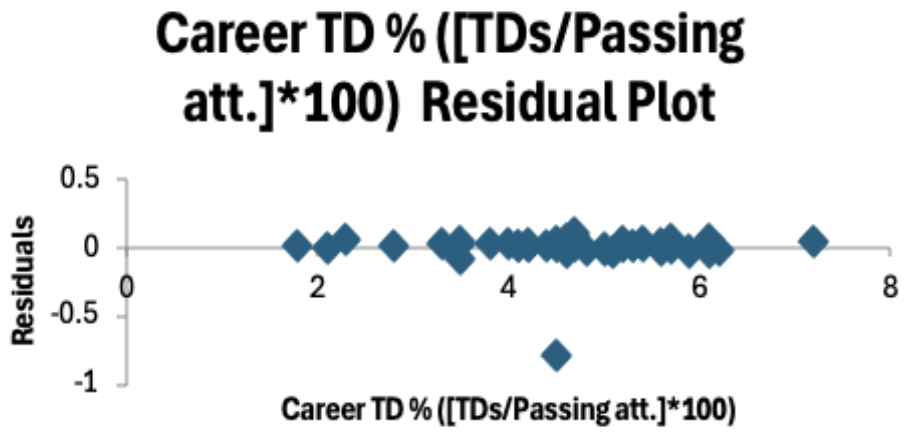
	Coefficients	Standard Erro	t Stat	P-value
Intercept	2.15206	0.39847	5.40083	2.5E-06
Career Completion %	0.83225	0.00627	132.747	6.3E-59
Career Yds/Att	4.1679	0.05261	79.2177	4.2E-49
Career TD % ([TDs/Passing att.]*100)	3.33834	0.02608	128.027	3.1E-58
Career Int % ([Int.//Passing att.]*100)	-4.19008	0.03957	-105.882	1.3E-54
Career Sack % ([Sck/Passing att.]*100)	0.00026	0.00056	0.47449	0.63749

RESIDUAL PLOTS









FINAL PARSIMONIOUS MODEL

	Coefficients	andard Erro	t Stat	P-value	Lower 95%	Upper 95%	ower 95.0%	pper 95.0%
Intercept	2.14489	0.39474	5.43369	2.1E-06	1.34984	2.93993	1.34984	2.93993
Career Completion %	0.83219	0.00621	133.921	3.5E-60	0.81967	0.84471	0.81967	0.84471
Career Yds/Att	4.16963	0.05203	80.1339	3.4E-50	4.06483	4.27443	4.06483	4.27443
Career TD % ([TDs/Passing att.]*100)	3.33797	0.02584	129.186	1.7E-59	3.28593	3.39001	3.28593	3.39001
Career Int % ([Int.//Passing att.]*100)	-4.18882	0.03914	-107.012	8.1E-56	-4.26766	-4.10998	-4.26766	-4.10998

y= 2.144 + 0.832*Career Comp. % + 4.17*Career Yds per Att. + 3.338*Career TD % - 4.189*Career Int. %

FINAL REGRESSION

Regression Statistics								
Multiple R	0.999894							
R Square	0.999788							
Adjusted R Square	0.999769							
Standard Error	0.123522							
Observations	50							
ANOVA								
	df	*SS*	*MS*	*F*	*ignificance F*			
Regression	4	3241.61	810.4026	53114.1	5.04E-82			
Residual	45	0.686599	0.015258					
Total	49	3242.297						
	Coefficients	*tandard Erro*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95.0%*	*pper 95.0%*
Intercept	2.144887	0.394738	5.433693	2.14E-06	1.349843	2.93993	1.349843	2.93993
Career Completion %	0.83219	0.006214	133.921	3.45E-60	0.819675	0.844706	0.819675	0.844706
Career Yds/Att	4.169627	0.052033	80.13389	3.4E-50	4.064827	4.274427	4.064827	4.274427
Career TD % ([TDs/Passing att.]*100)	3.33797	0.025838	129.1864	1.74E-59	3.285929	3.390011	3.285929	3.390011
Career Int % ([Int.//Passing att.]*100)	-4.18882	0.039143	-107.012	8.09E-56	-4.26766	-4.10998	-4.26766	-4.10998

Chart Area

CONCLUSION AND APPLICATION

- In the beginning we started off by looking at Quarterback's career completion %, career Yd/att, career TD%, career int%, career sack%, career Pass att/game, avg rushing yards/game, and passer rating.
- We took out three variables because of their high p-values: career pass att/game, career sack %, and average rushing yards/game
- We ran a final regression to see the most significant and least significant variables
- The most significant variable would be career int. % because it had the largest and holds a negative relationship with passer rating
- The least significant variable would be career comp. % because it is the lowest coefficient making it the least significant variable in our data with a positive relationship

WORKS CITED

- "Pro Football Stats, History, Scores, Standings, Playoffs, Schedule & Records." *Pro Football Reference* , www.pro-football-reference.com/. Accessed 29 Apr. 2024.