

KEY NBA STATISTICS INFLUENCING

MINUTES PLAYED PER GAME: 2023-2024

REGULAR SEASON ANALYSIS

GROUP 7

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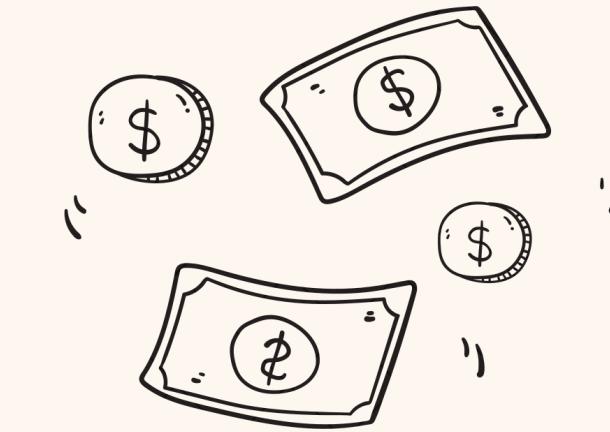


A boy's dream...



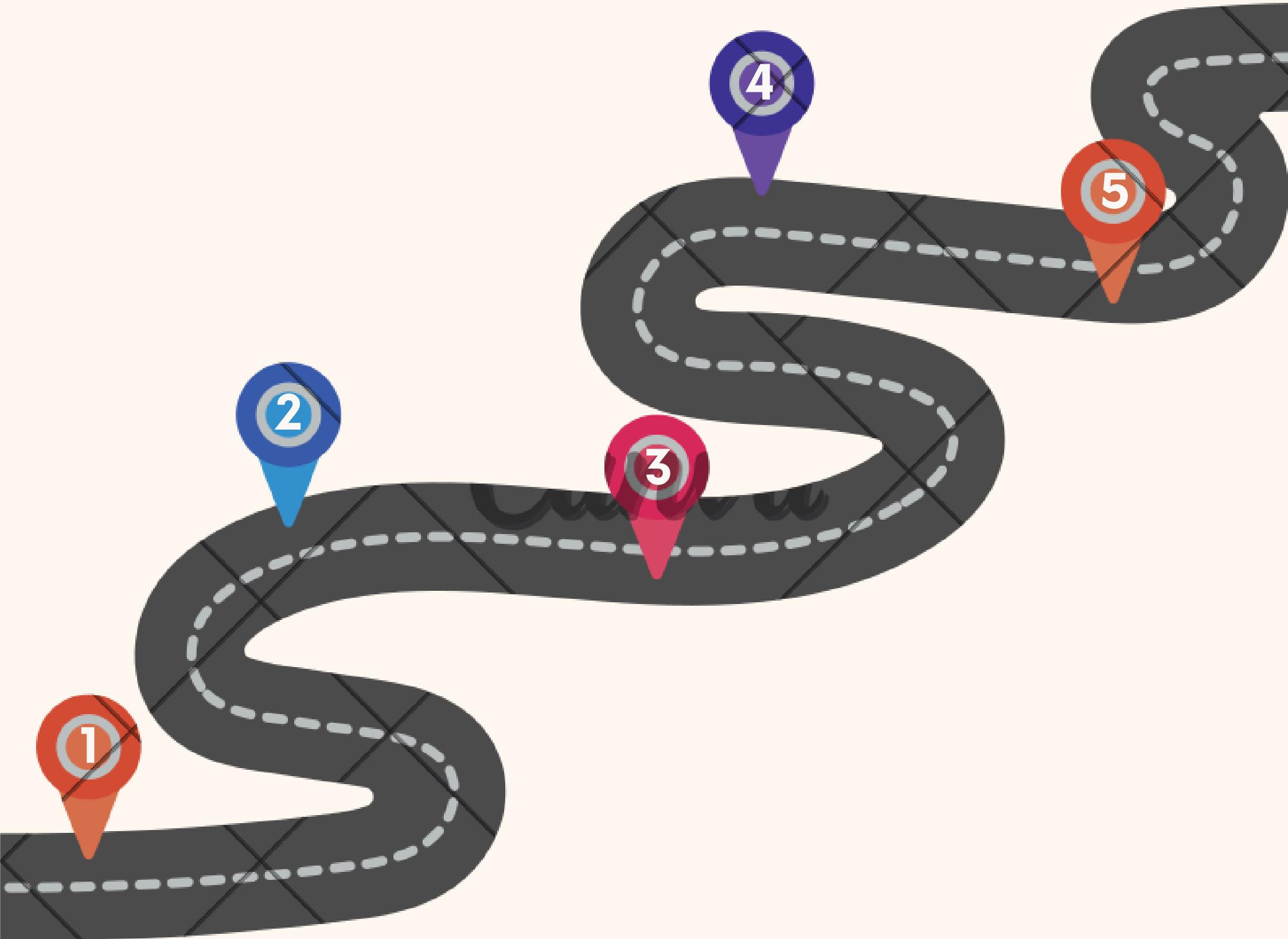
MOTIVATION

- Big business
 - average NBA team is worth \$4.42 Billion USD!
- Contract Differences
 - players with more playing time get paid more!



1. What are the most important predictors in response to the Total Minutes played per Game in the 2023 NBA season?
2. What can an NBA player work on to increase their Total Minutes Played per Game?

METHODOLOGY



A Quick Roadmap:

1. Multicollinearity and VIF test
2. Stepwise & Anova - Additive vs. Multicollinearity Model
3. Final Additive Model:
Interactions & Polynomial
4. Multiple Linear Regression
Assumptions
5. Predictions

DATASET

- Statistics of every NBA player's per game averages during the 2023-24 season

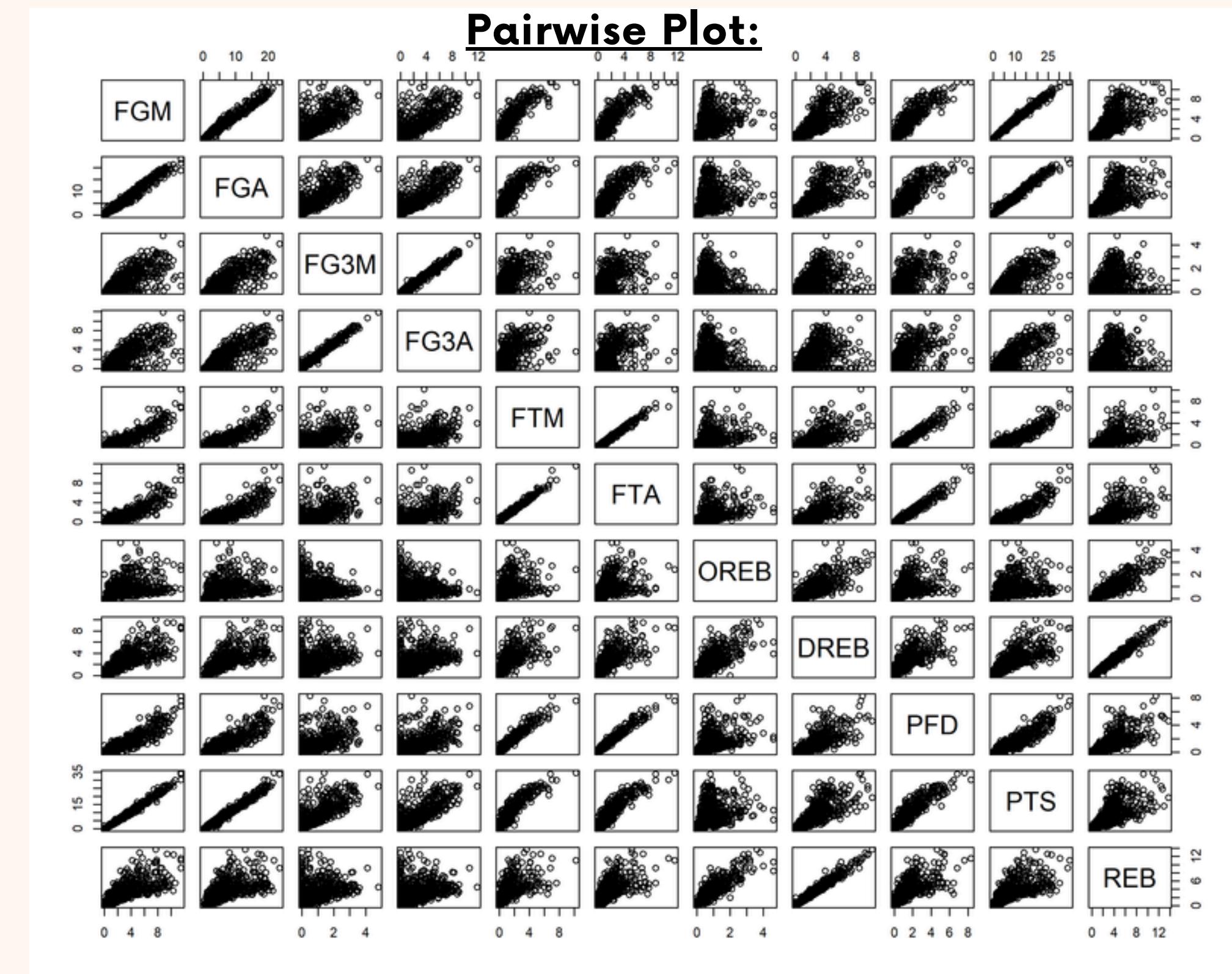
- Data obtained from [NBA.com/stats](https://www.NBA.com/stats)

- 24 independent predictors
- 1 responding variable (MIN- minutes played per game)

GP	MIN	FGM	FGA	FG_PCT	FG3M	FG3A	FTM	FTA	OREB	DREB	REB	AST	TOV	BLK	PF	PFD	PTS	PLUS_MINUS	DD2	TD3	STL	BLKA	FT_PCT	FG3_PCT
1 42	7.4	1.3	2.9	0.446	0.3	1.2	0.4	0.5	0.3	0.9	1.2	0.5	0.3	0.1	0.5	0.3	3.2	0.4	0	0	0.2	0.2	0.652	0.26
2 56	11	1.5	3.5	0.423	1.2	3	0.3	0.3	0.2	1	1.1	0.5	0.2	0.1	0.9	0.4	4.5	0.9	0	0	0.2	0.1	0.895	0.408
3 20	8.5	0.9	3.1	0.29	0.5	2	0.1	0.1	0.1	0.8	0.9	0.3	0.4	0.1	0.3	0.1	2.4	-2.6	0	0	0.1	0.2	1	0.256
4 73	31.5	5.5	9.8	0.556	0.5	1.9	2.4	3.7	2.4	4.1	6.5	3.5	1.4	0.6	1.9	3.1	13.9	5.8	12	0	0.8	0.8	0.658	0.29
5 78	16.3	2.4	5.3	0.446	1.1	2.8	0.7	0.8	0.3	1.3	1.6	1.8	0.7	0.1	1.6	0.8	6.6	1.1	0	0	0.5	0.3	0.921	0.387
6 72	27.7	4.4	8.8	0.496	1.9	4.6	1.5	1.9	0.9	2.9	3.8	1.5	0.9	0.7	3.3	2	12.2	2.2	1	0	0.9	0.7	0.781	0.419

MULTICOLLINEARITY

VIF Multicollinearity Diagnostics		
	VIF detection	
GP	2.2758	0
FGM	4504.1157	1
FGA	198.6233	1
FG_PCT	2.4223	0
FG3M	209.5221	1
FG3A	83.0241	1
FTM	419.2247	1
FTA	110.8351	1
OREB	235.4159	1
DREB	1423.7317	1
REB	2495.5506	1
AST	5.4586	0
TOV	9.0757	0
BLK	2.3220	0
PF	3.7188	0
PFD	33.4965	1
PTS	8544.5076	1
PLUS_MINUS	1.4922	0
DD2	4.7619	0
TD3	1.8469	0
STL	2.8005	0
BLKA	4.3051	0
FT_PCT	1.6140	0
FG3_PCT	1.6962	0



MULTICOLLINEARITY

VIF Multicollinearity Diagnostics		
	VIF detection	
GP	2.1994	0
FG_PCT	1.5253	0
AST	5.1341	0
TOV	8.0069	0
BLK	2.2725	0
PF	3.4217	0
PLUS_MINUS	1.3392	0
DD2	4.4973	0
TD3	1.7610	0
STL	2.6256	0
BLKA	3.1041	0
FT_PCT	1.4457	0
FG3_PCT	1.5188	0
FG3M	2.7040	0
FTM	4.5039	0
REB	6.3768	0

The final model after multicollinearity is:

MIN=GP + FG_PCT + AST + TOV + BLK + PF + PLUS_MINUS + DD2 + TD3 + STL + BLKA + FT_PCT + FG3_PCT + FG3M + FTM + REB

ADDITIVE MODEL

H₀: The reduced model is a better fit for the data compared to the full model.
H_a: The full model is a better fit for the data compared to the reduced model.

Source	DF	Sum of Squares (SS)	Mean Square (MS)	F- Statistic	P-Value
Regression	6	52.358	8.7263	1.3584	0.2294
Residual Error	555	3565.4	6.4241		
Total	561	3617.7	6.4487		

Analysis of Variance Table for Stepwise Additive and Multicollinearity model

Multicollinearity:

- **MIN** =
GP+FG_PCT+AST+TOV+BLK+PF+PLUS_MINUS+DD2+TD3+STL+BLK+BLKA+FT_PCT+FG3_PCT+FG3M
+FTM+REB

Stepwise:

- **MIN** = GP + PF + FG3M + REB + AST - DD2 + STL - PLUS_MINUS - TD3 + BLKA

INTERACTIVE MODEL

Interaction:

- **MIN** = GP + PF + FG3M + REB + AST - DD2 + STL - PLUS_MINUS + BLKA - FG3M*AST - AST*STL - REB*AST + PF*GP - REB*PLUS_MINUS + GP*PLUS_MINUS

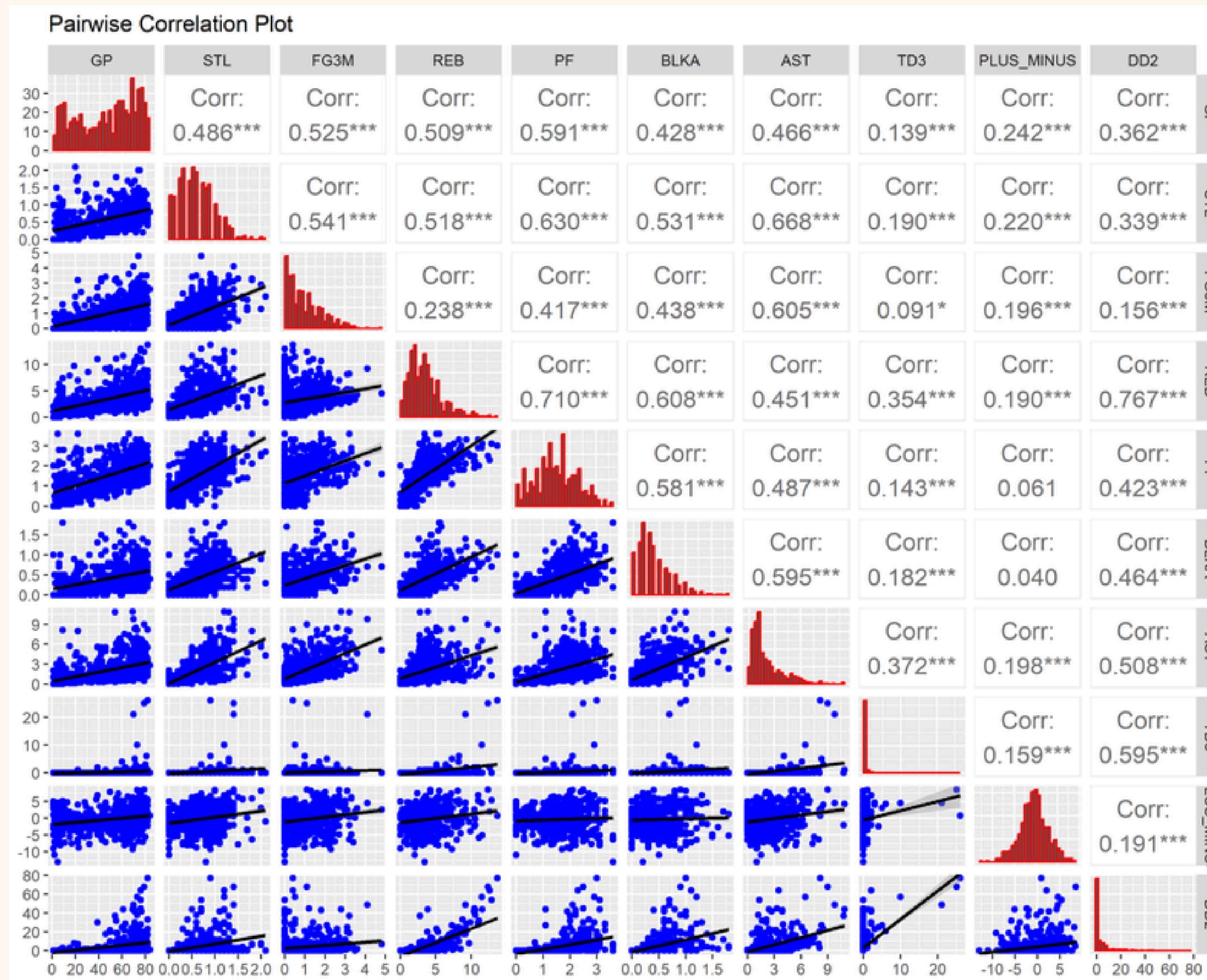
Additive:

$$\mathbf{MIN} = \mathbf{GP} + \mathbf{PF} + \mathbf{FG3M} + \mathbf{REB} + \mathbf{AST} - \mathbf{DD2} + \mathbf{STL} - \mathbf{PLUS_MINUS} - \mathbf{TD3} + \mathbf{BLKA}$$

Source	DF	Sum of Squares (SS)	Mean Squares (MS)	F-Statistic	P-Value
Regression	5	391.83	78.366	13.507	1.888e-12
Residual Error	556	3225.9	5.801		
Total	561	3617.7	6.448		

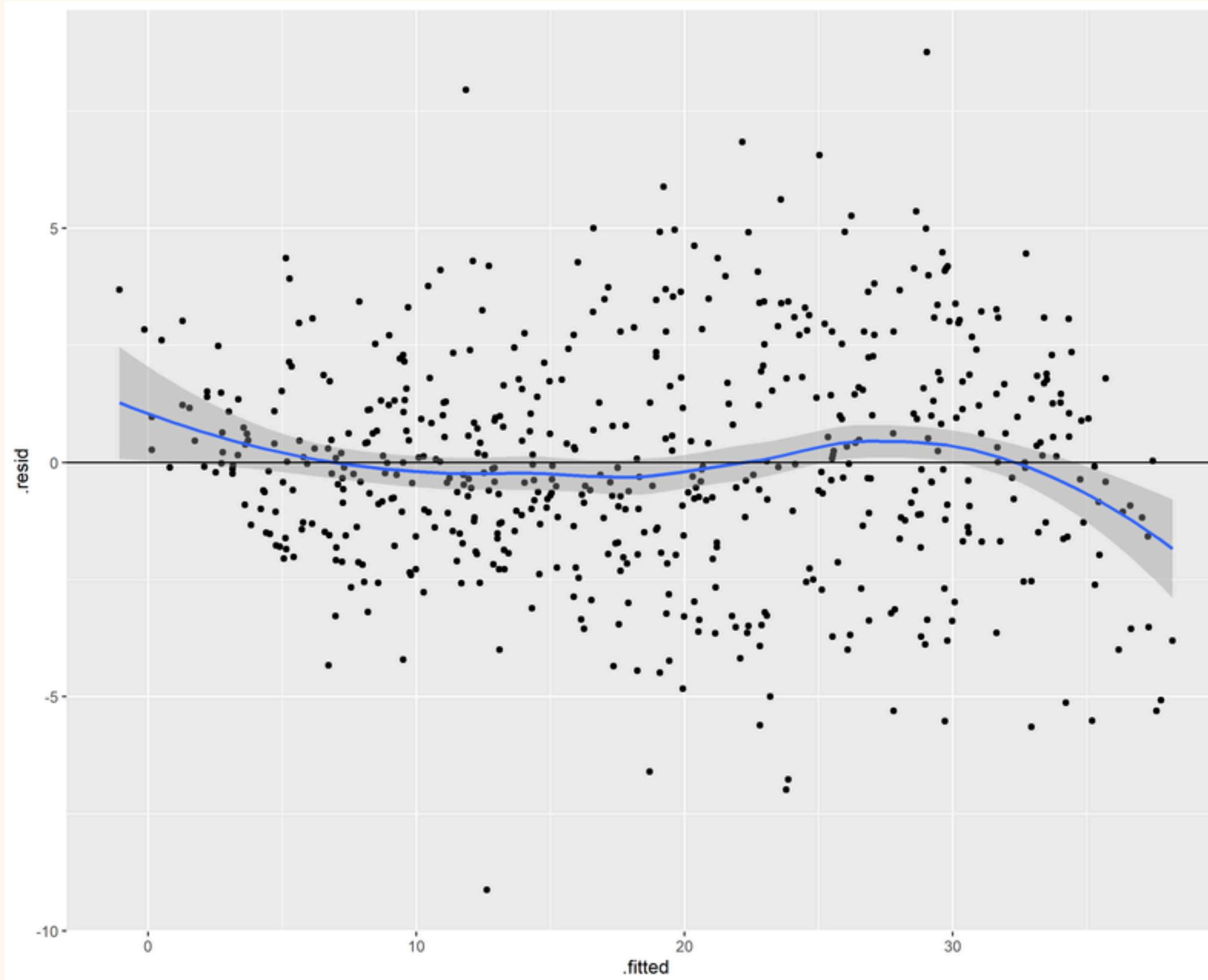
Analysis of Variance Table for Interaction and Additive model

POLYNOMIAL



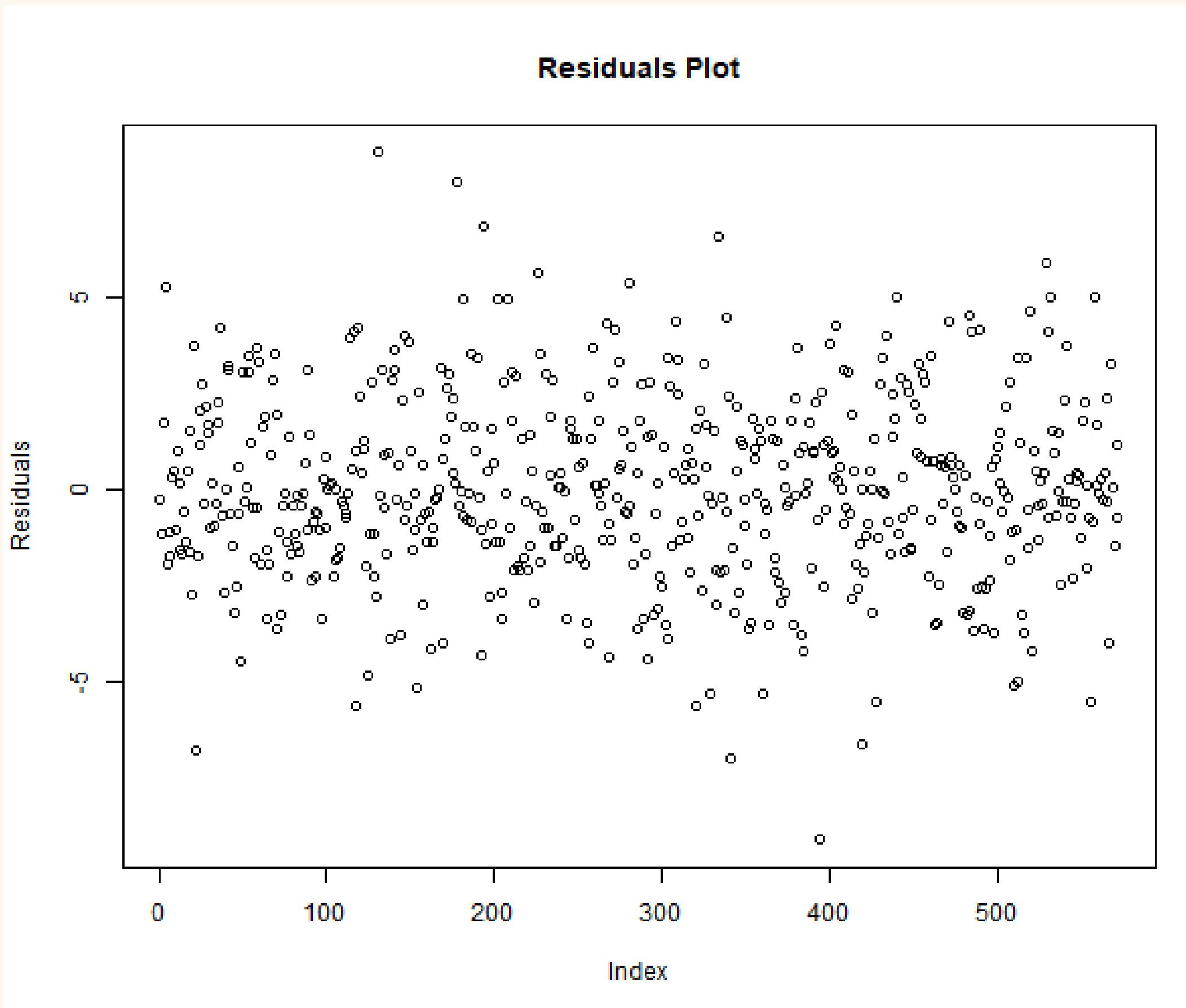
- DD2 and REB
- Adjusted R-Square : 0.9411

LINEARITY ASSUMPTION



- No discernible pattern
- Residuals show a distinct curved pattern
- Nonlinear relationship
 - Linearity assumption has been violated

INDEPENDENCE ASSUMPTION



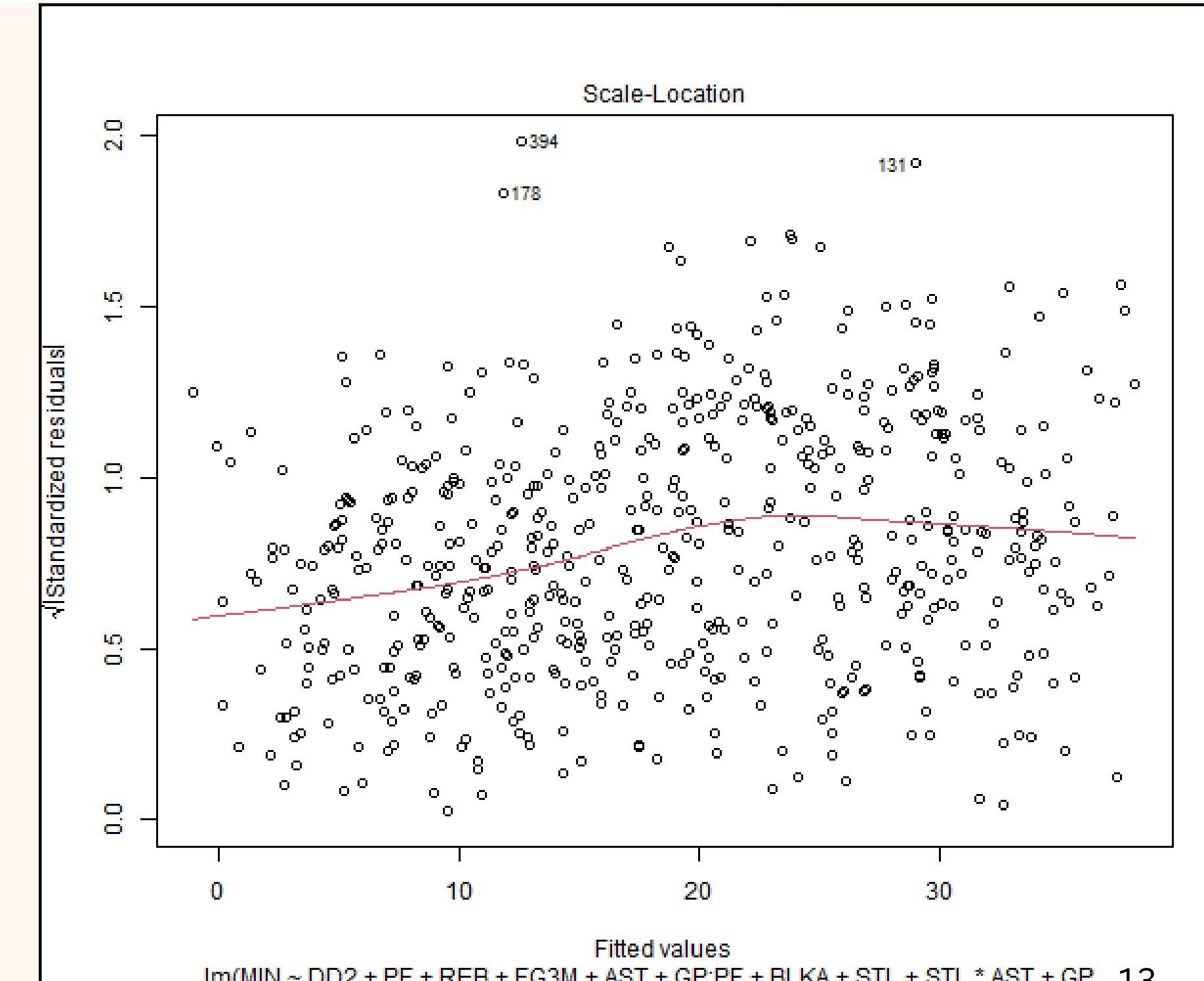
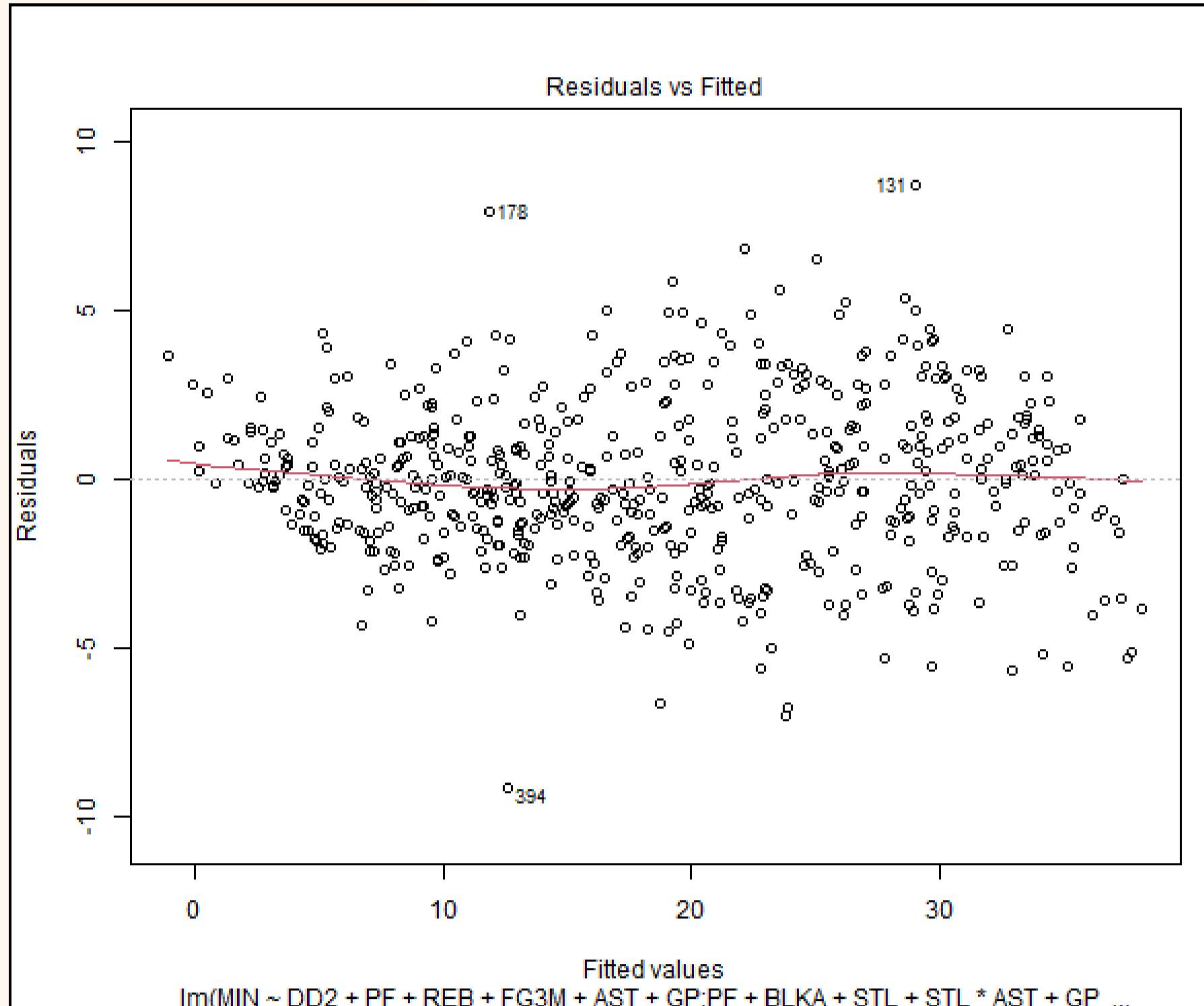
- No trends/patterns and see an equal scatter of points
 - Independence assumption has passed



EQUAL VARIANCE

H_0 = Homoscedasticity

H_a = Heteroscedasticity



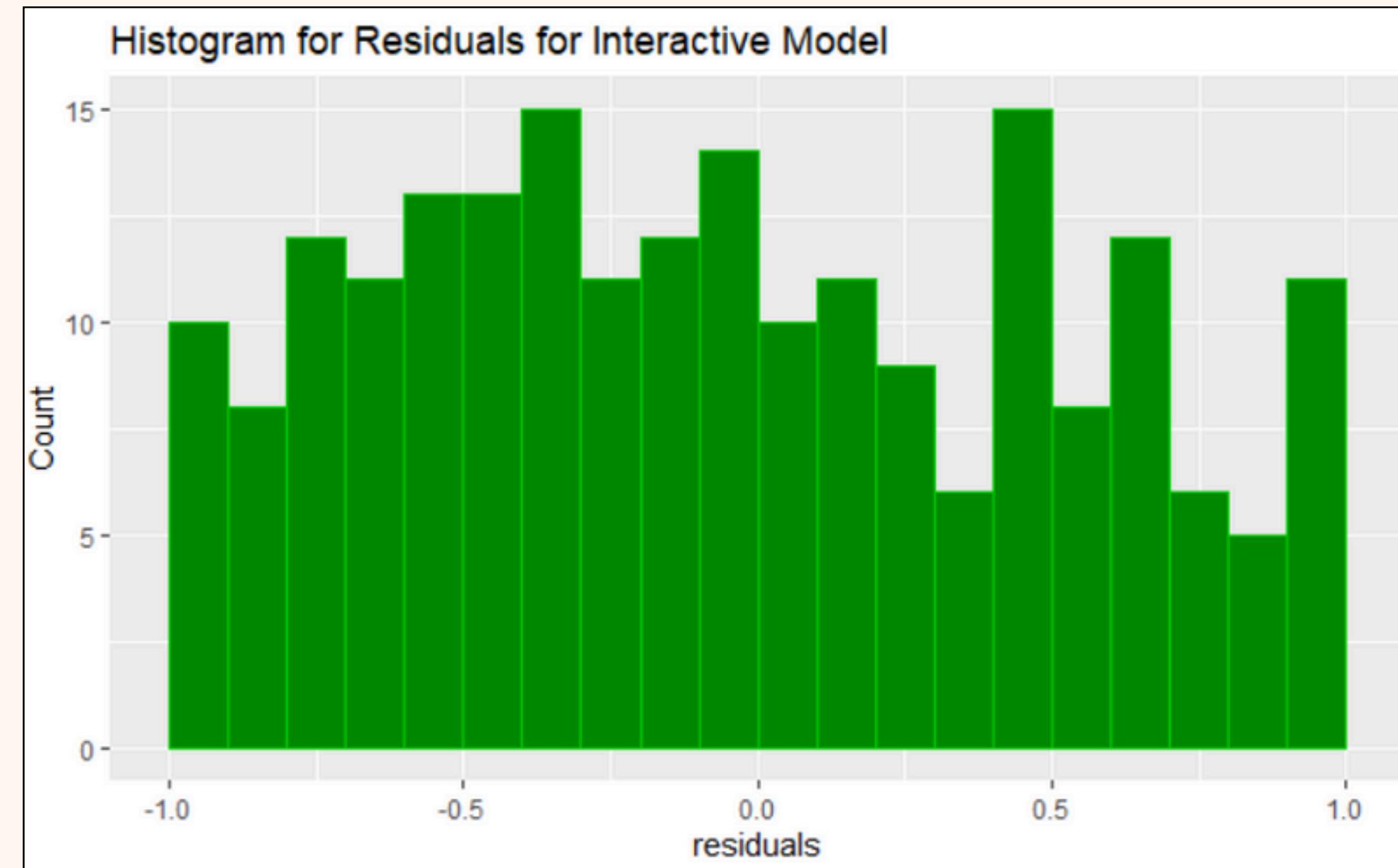
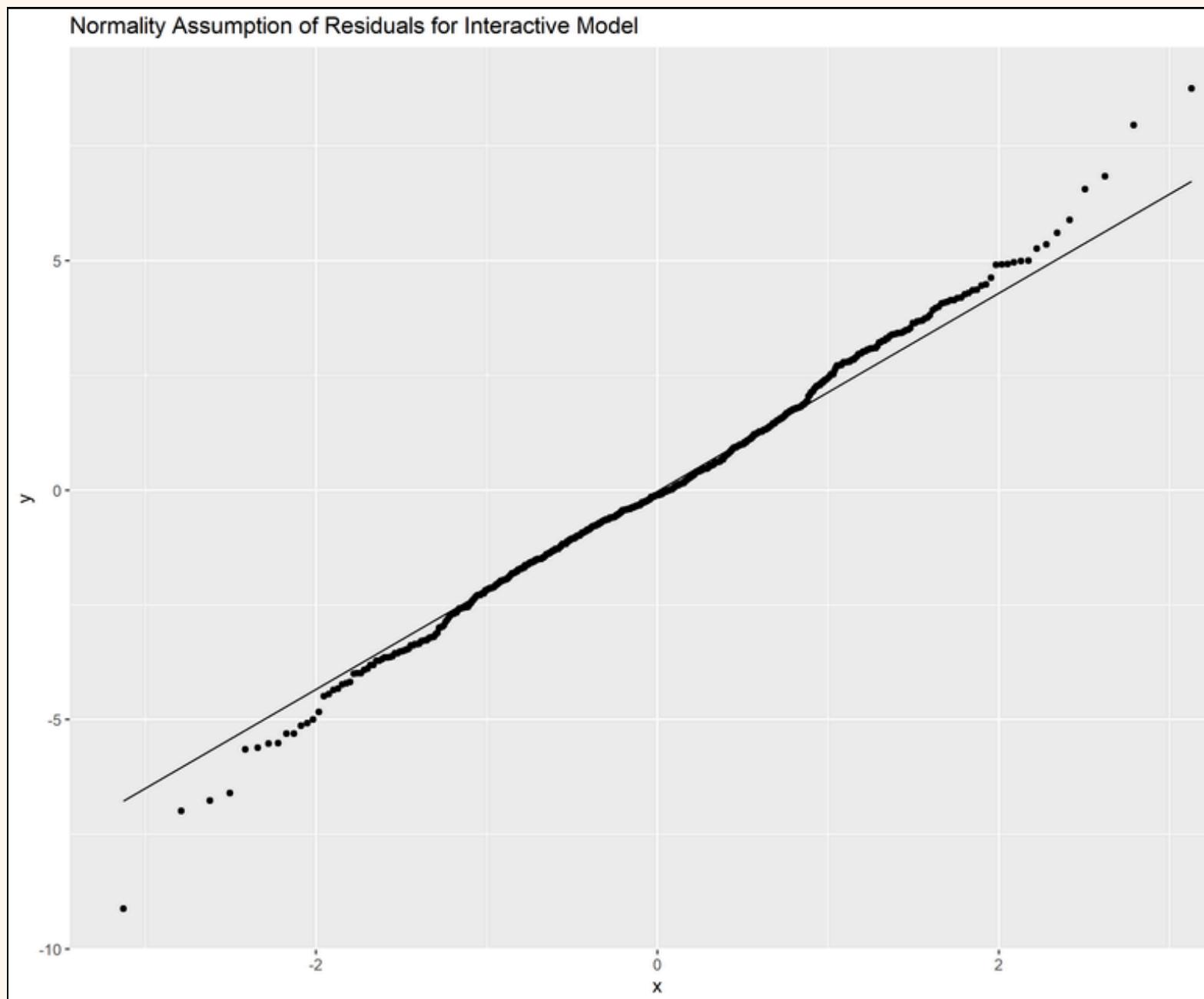
Breusch-Pagan Test: **8.088e^-6**

NORMALITY



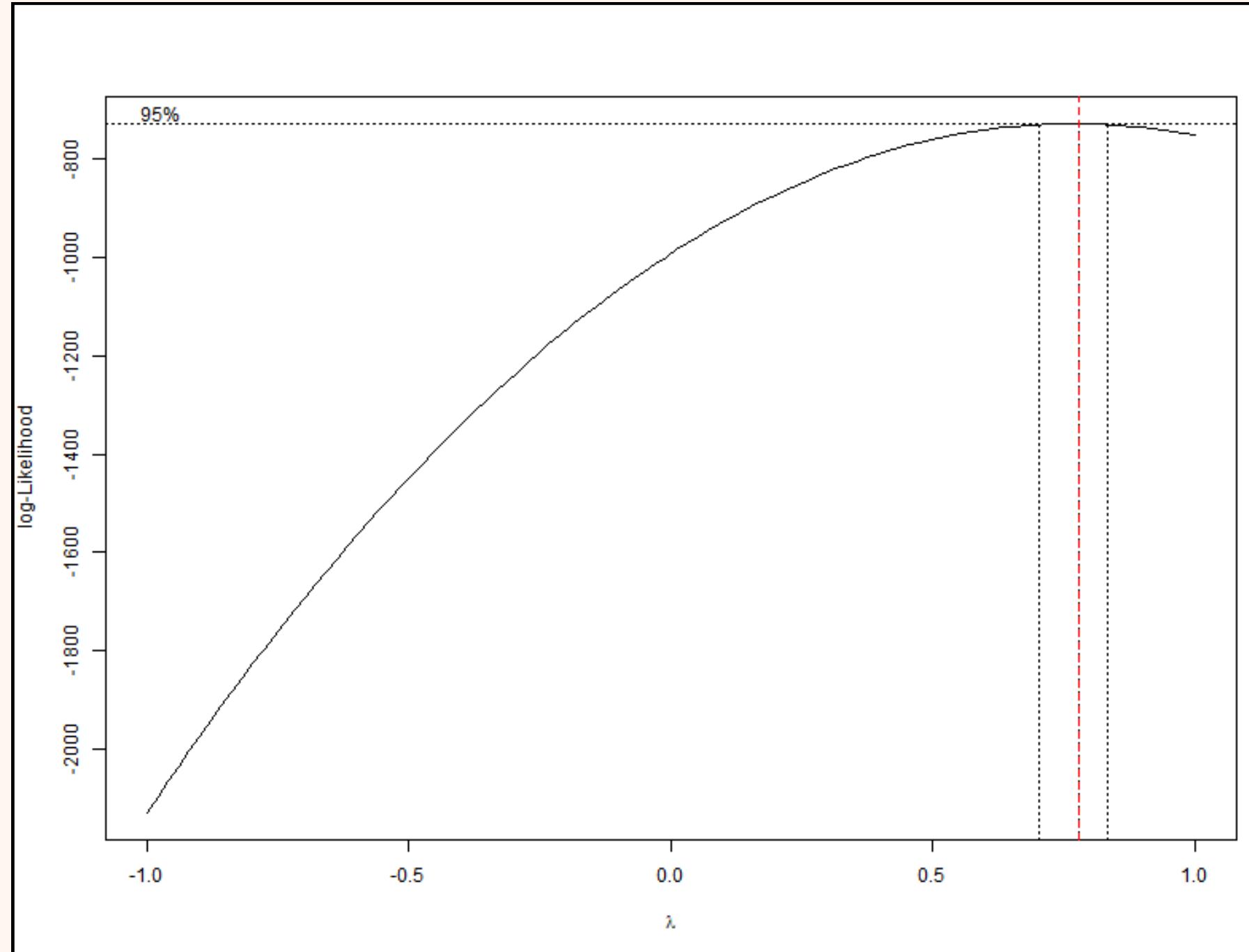
H_0 = Normality

H_a = No Normality

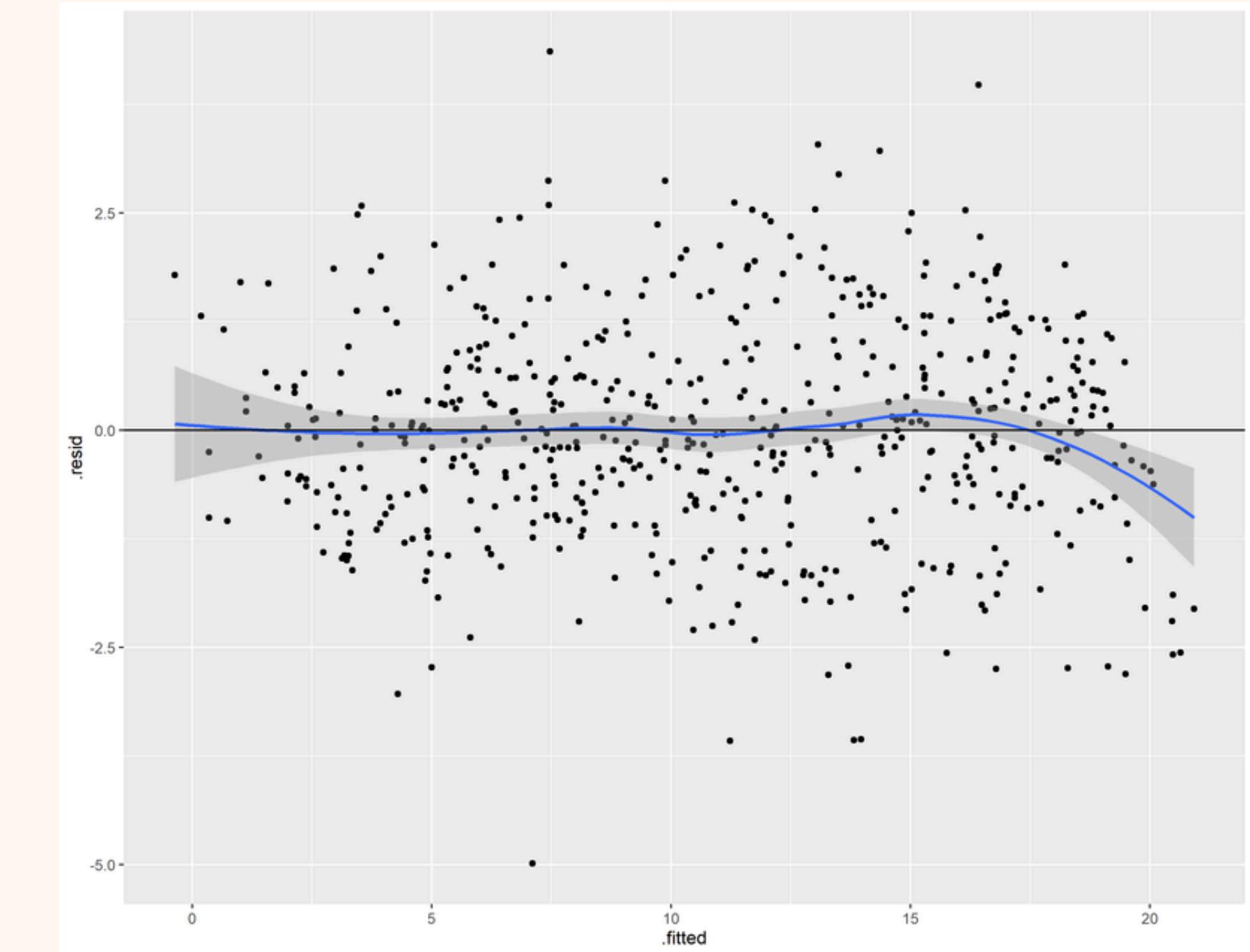


Shapiro-Wilk test p-value: **0.04761**

BOX-COX TRANSFORMATION



Best Lambda Value: **0.777778**

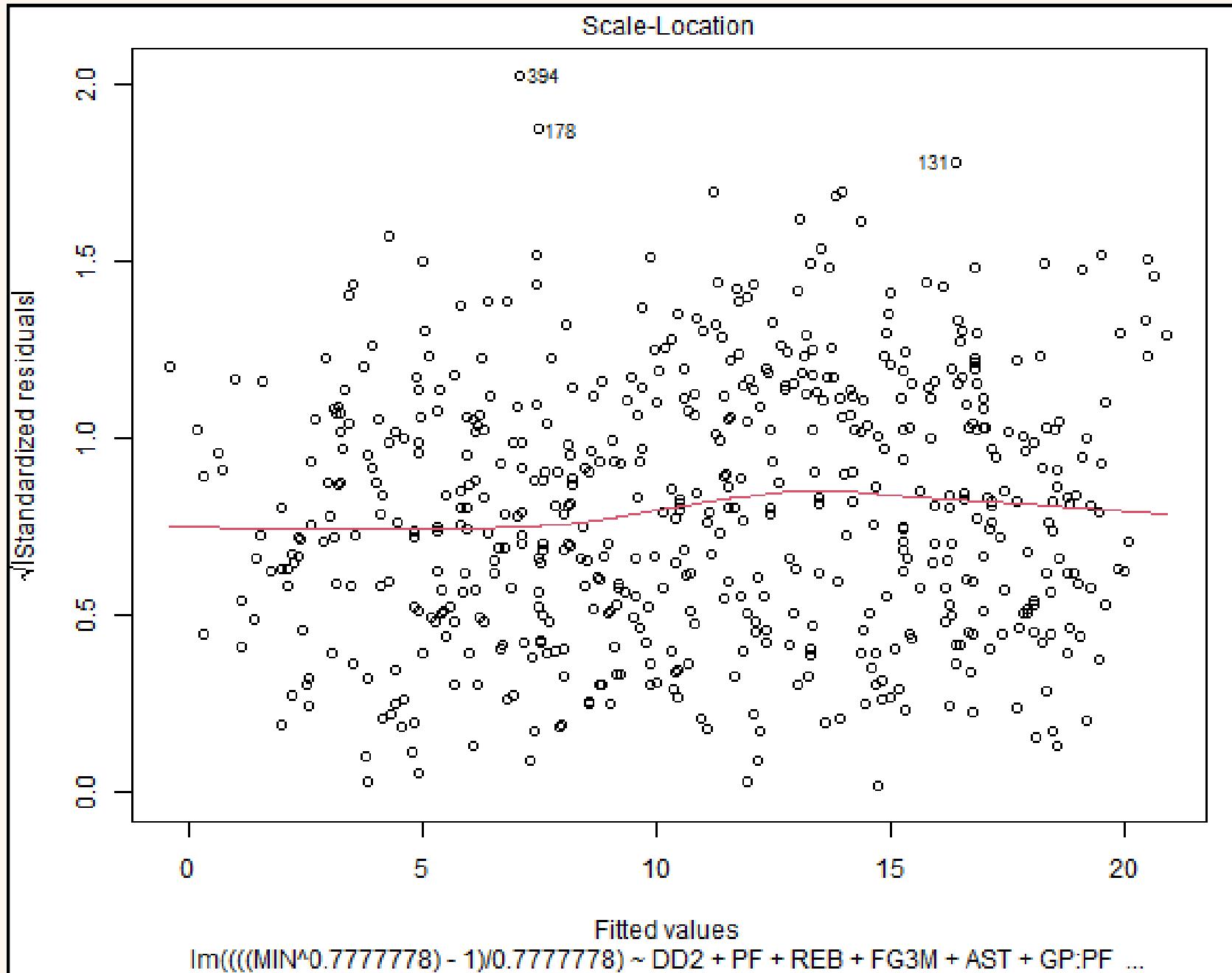


BOX-COX TRANSFORMATION

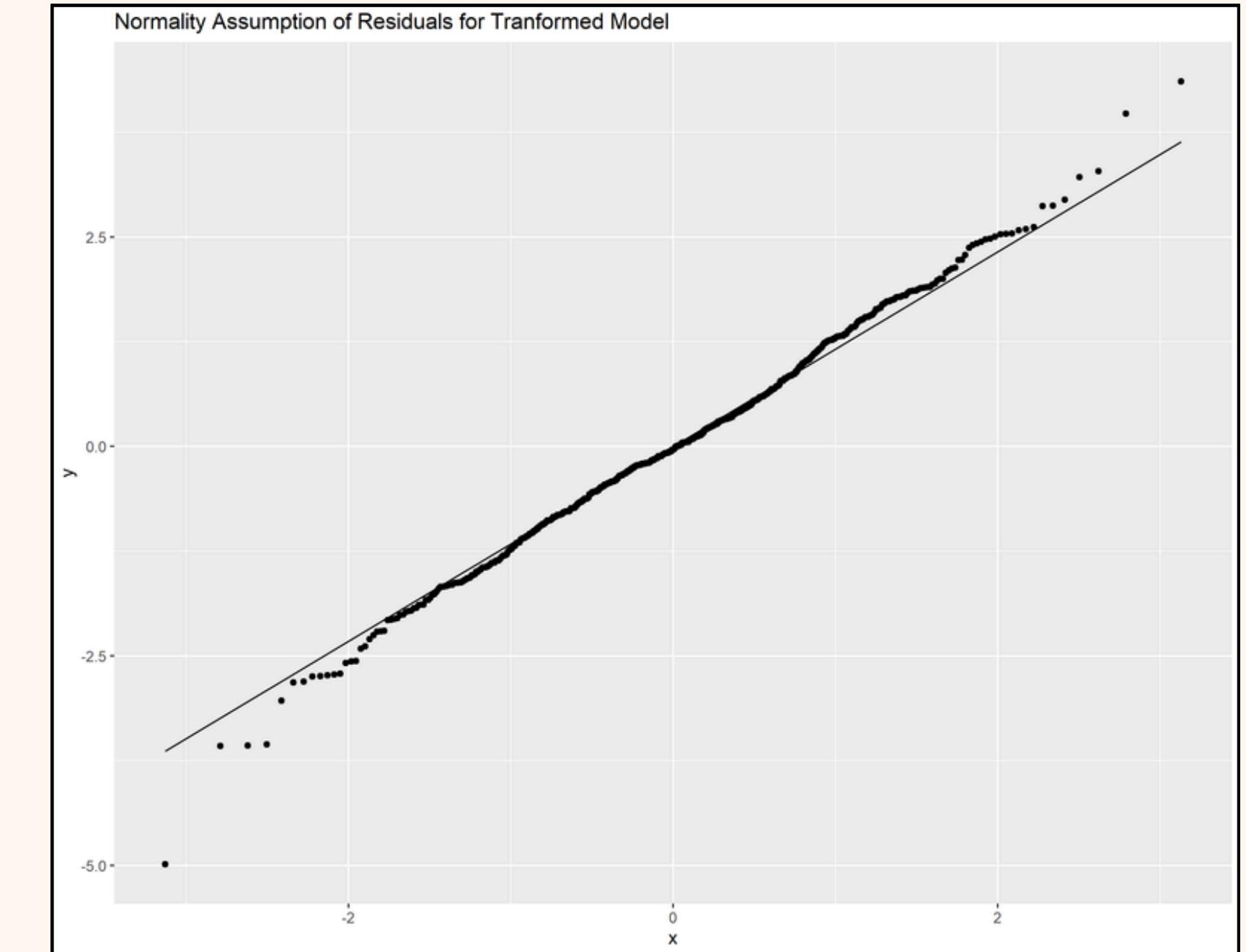
H_0 = Homoscedasticity
 H_a = Heteroscedasticity



H_0 = Normality
 H_a = No Normality

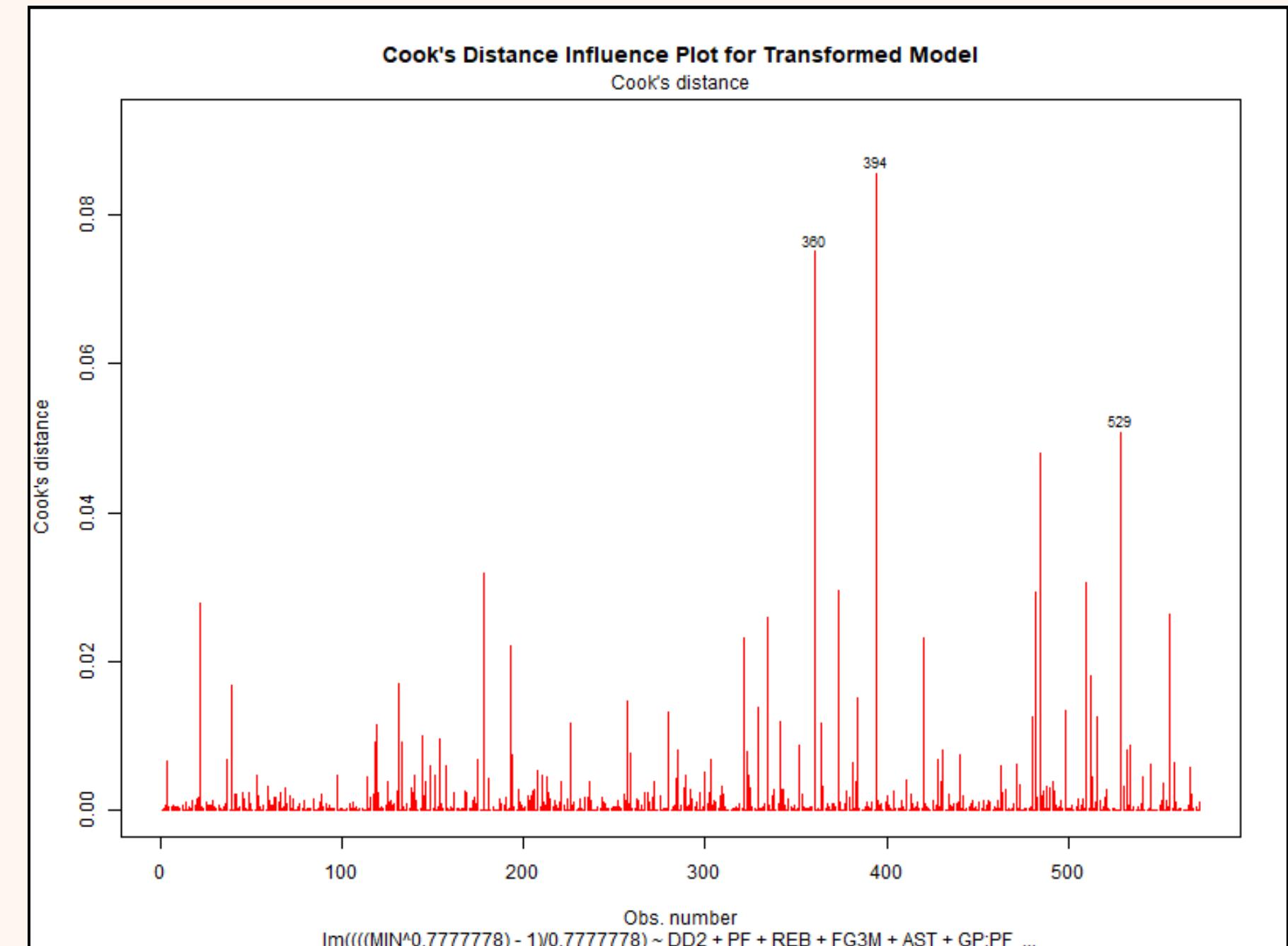
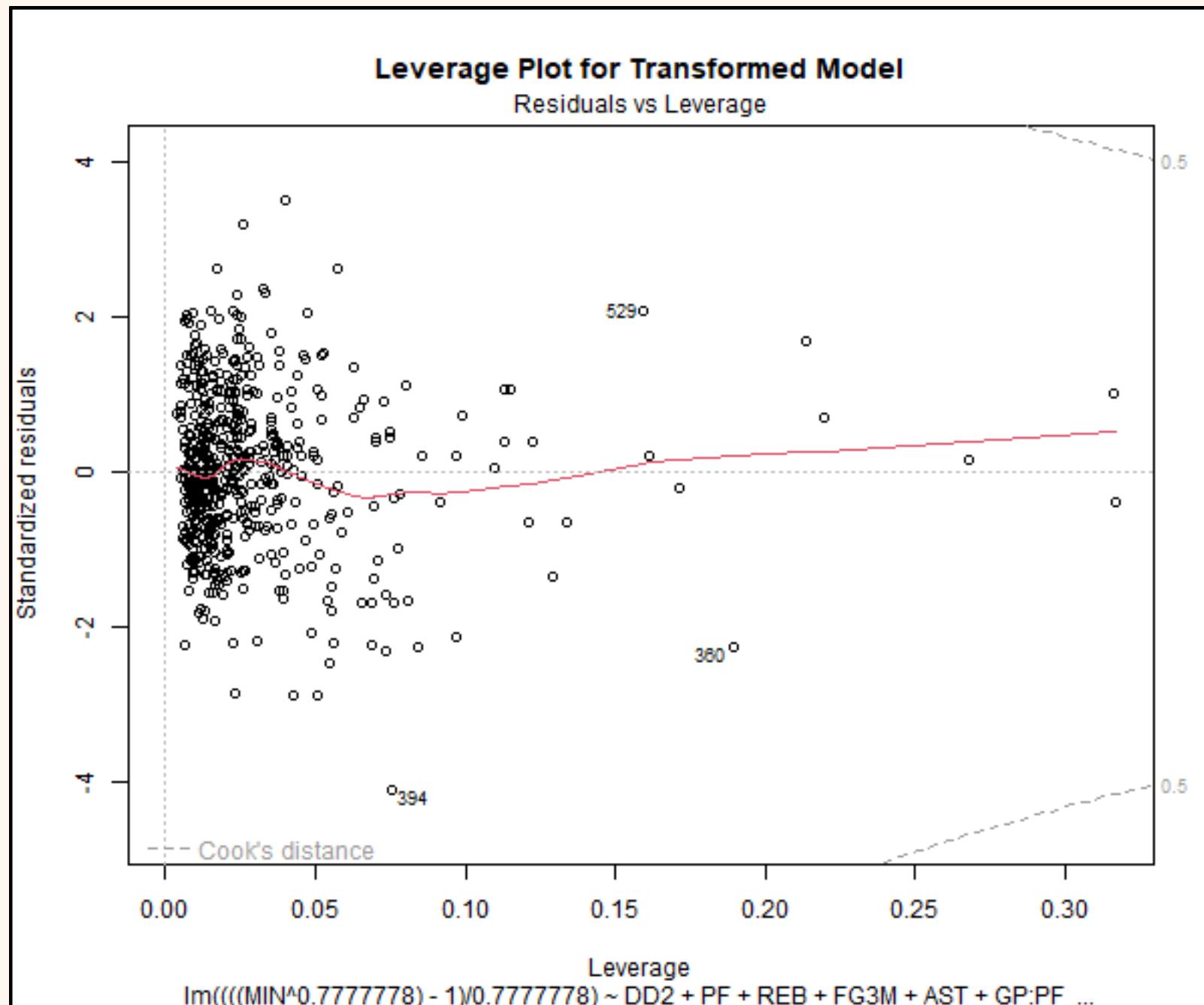


Breusch-Pagan p-value: **0.0005639**



Shapiro-Wilk p-value: **0.2076**

OUTLIERS



No outliers found!¹⁷

MODELS & PREDICTIONS

Models	Mean Absolute Error	Training Accuracy	Testing Accuracy
Transformed Model	86.19	13.76%	4.68%
Interactive Model	6.59	94.52%	92.71%

Transformed Model Assumptions

Linearity	✗
Independence	✓
Equal Variance	✗
Normality	✓

Interactive Model

Linearity	✗
Independence	✓
Equal Variance	✗
Normality	✗

Final Model:

MIN = GP + PF + FG3M + REB + AST + STL + BLKA + GP * PLUS_MINUS - DD2 - PLUS_MINUS - PF * GP - AST * STL - REB * PLUS_MINUS - FG3M * AST - REB * AST

CONCLUSION

Factors having positive impact on minutes played

1. What are the most important predictors in response to the Total Minutes played per Game in the 2023 NBA season?
2. What can an NBA player work on to increase their Total Minutes Played per Game?

Games Played (GP)

Personal Fouls (PF)

Three-Point Field Goals Made (FG3M)

Rebounds (REB)

Assists (AST)

Steals (STL)

Attempted Blocks (BLKA)

GP * PLUS_MINUS

Thank you!



~Safron James, circa 2020