Analysis on yearly average SAT Math Scores for Forecasting

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Background

Our non-seasonal time series datapoints are average scores on the math portion of the SAT from 1972 through 2018. We chose to do this because SAT scores are on the decline and thought it would be interesting to see where the scores end up if everything is held constant. We chose to do just the math portion of the score because in Spring of 2016 the critical reading and writing categories were merged into one category, while math has remained in its own category. The data is taken from the college board, so it is very valid and reliable. Regarding length of the amount of time that we looked back, we believed that as far back as we could go was acceptable because there were no big changes in math and no major changes to how it was scored. It is worth noting that the score for math was at its lowest point around 1980 and a major event that happened was the creation of the internet in 1983, and it appears that the score took off from there until about 2005. The score has since reached a point similar to the beginning of the sampling in 1972.

Identification

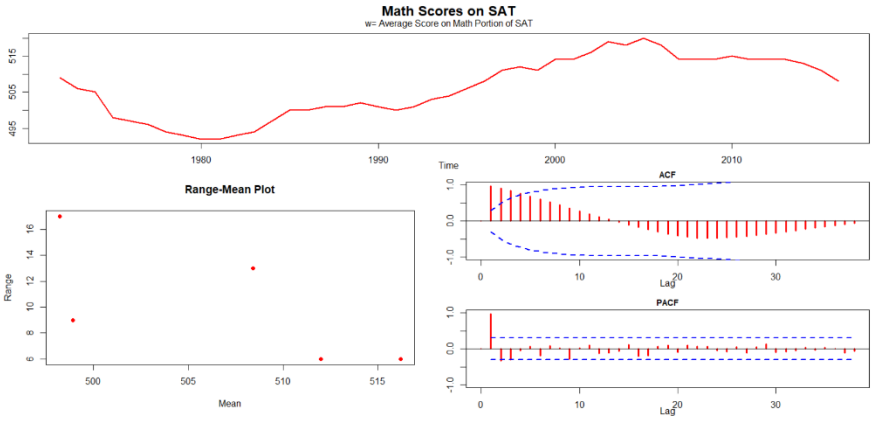
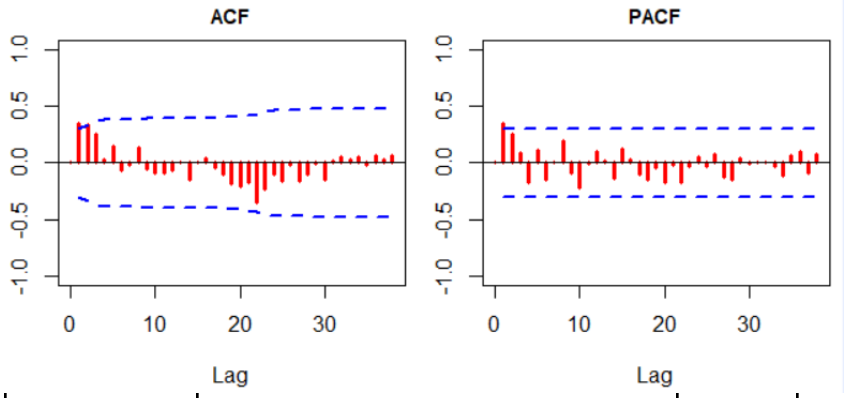


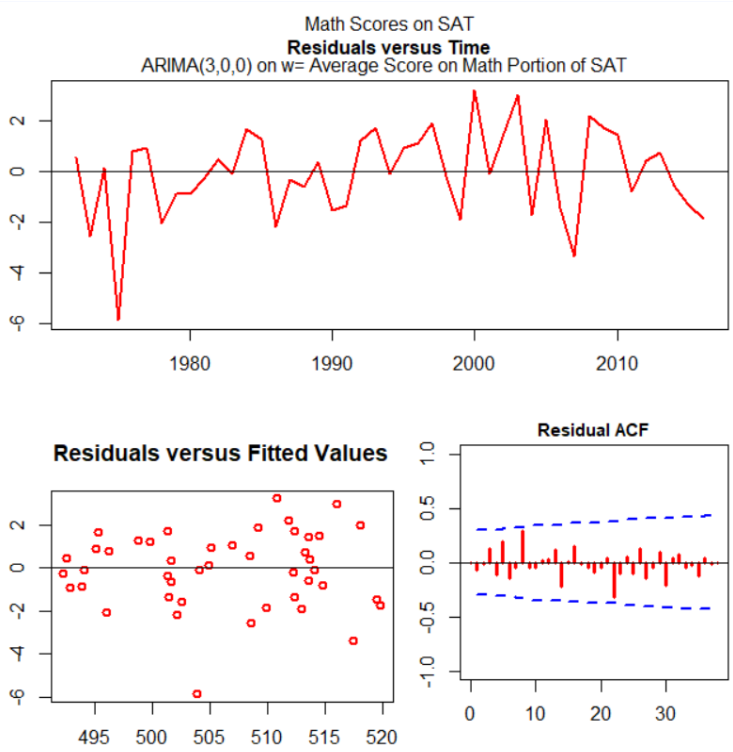
Figure 1 Original Iden output

From looking at the Range-Mean plot and the ACF, it was pretty apparent that we would be needing to take a difference but take care not to over differentiate. However, it could be noted that an interpretation could be that the ACF is dying down and the PACF cuts off after 1 or 3 leading to a potential AR(1) or AR(3) model.

After taking the first difference we concluded that the ACF dies down and the PACF cut off after 2, leading to a tentative identification of an ARIMA(2,1,0).



	ARIMA (p,d,q) models				
Model	(1,0,0)	(3,0,0)	(2,1,0)	(1,0,1)	(2,0,1)
d	0	0	1	0	0
φ_1	0.958	1.221	0.2808	.00152	.32487
φ_2		0.03353	0.2779		.59444
φ_3		-0.3142			
Θ_1				-.00129	-.999998
Sig $\hat{\rho}_k(\hat{a})$	1,2	N/A	N/A	3	3
S	1.98	1.7345	1.8046	1.8891	1.8111
AIC_C	197.88	190.6948	183.1419	195.7015	196.3067
-2log(Likelihood)	191.88	180.6498	177.1419	187.7015	186.3067
Ljung-Box χ^2_6	19.08869	9.9361	8.7329	12.58945	13.84079



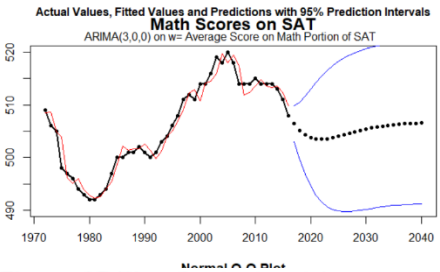
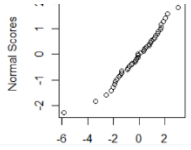


Figure AR(3) esti output part 1



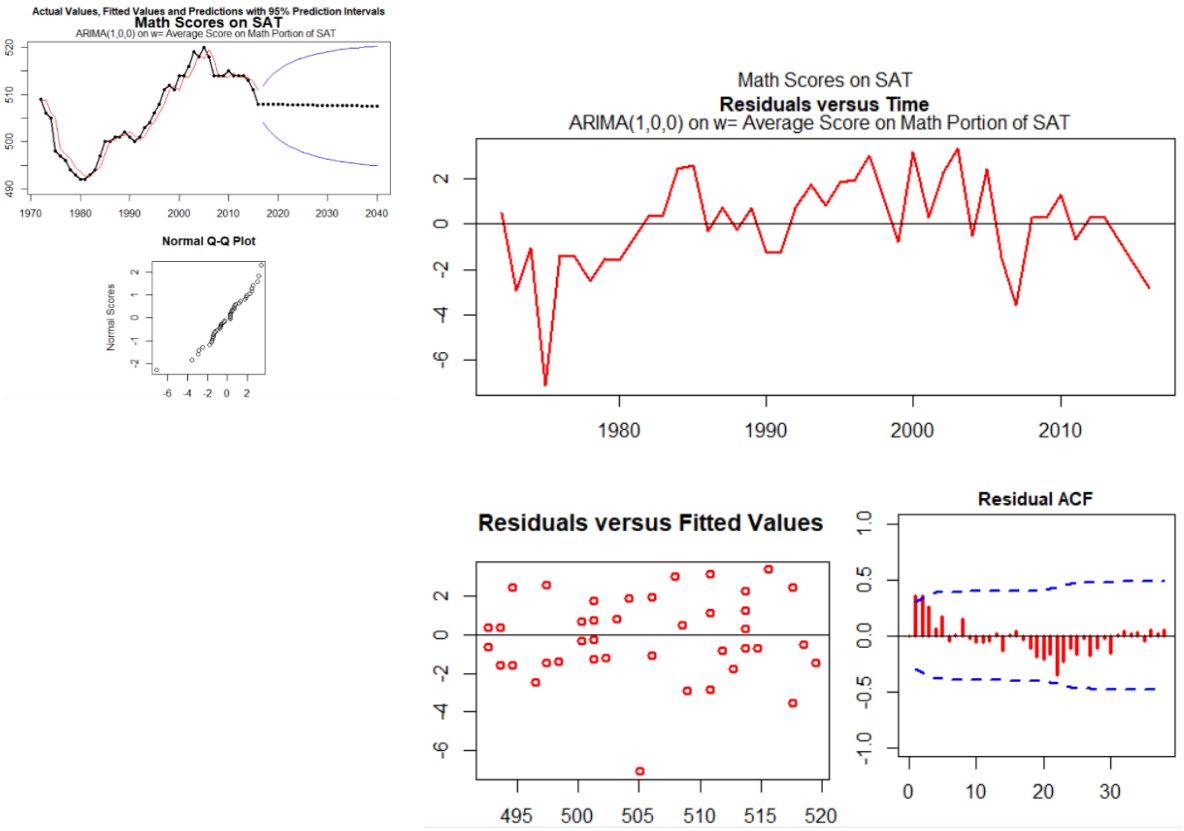


Figure 4 AR (1) esti output part 2

We decided to compare the forecasts of the AR(1) model and the AR(3) model because according to the table those are the best models. The prediction interval for the AR(3) is much larger than the prediction interval for the AR(1) model. The AR(1) model predicts a constant slight decline in scores and the AR(3) predicts a decline in scores and a subsequent increase in scores starting in about 2021.