

Computational Modeling – Assignment 3

Multivariate Linear Models

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21/05/2018

Link to Github: <https://github.com/Carolinecasey17/ComputationalModels.Portfolio3.All.git>

1) Assess the relation between symptom severity and IQ (focus on visit 1 and children with ASD) and report the model, a plot of the model, a couple of lines describing the quality of the model and interpreting the results.

Model assessing ADOS ~ Verbal IQ

Output:

	Mean	StdDev	5.5%	94.5%
a	0.00	0.12	-0.19	0.19
b	-0.71	0.12	-0.90	-0.52
sigma	0.68	0.08	0.55	0.81

There seems to be a quite strong negative correlation between verbal IQ and ADOS. When verbal IQ increases by 1 standard deviation (corresponding to 7.6 points on the scale) ADOS decreases by 0.71 sd (corresponding to 3.3 points on the scale). In other words, the higher the IQ, the lower the ADOS score.

We chose to scale both variables mainly for the sake of interpretability. The verbal IQ and ADOS might be defined in terms of some characteristics (e.g. in the case of 'normal' IQ which has a mean of 100), but we are unaware of this. Since the numbers are otherwise fairly arbitrary. It is hard to know if an increase in 5 verbal IQ a lot? Or is 15?) we chose to scale, since it is easy to grasp the magnitude of effects in terms of standard deviation.

We choose very liberal and uninformed priors all around, since we have very little prior knowledge of the distribution of values beforehand. Since our values are scaled we decided to set the mean for both alpha, beta and sigma to be 0. For the SD in the prior for alpha and the beta for verbal IQ we set it to 1

for a quite liberal prior. Allowing sigma to be practically completely driven by the data by setting its sd to 3.

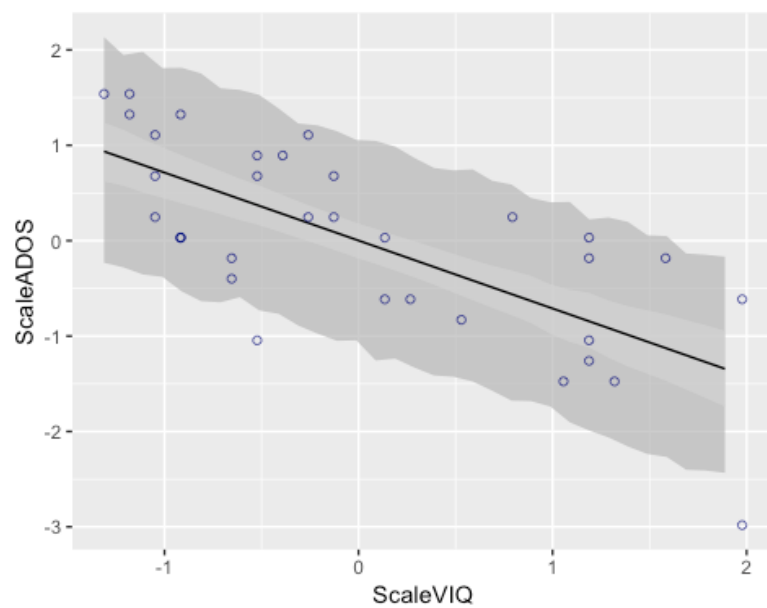
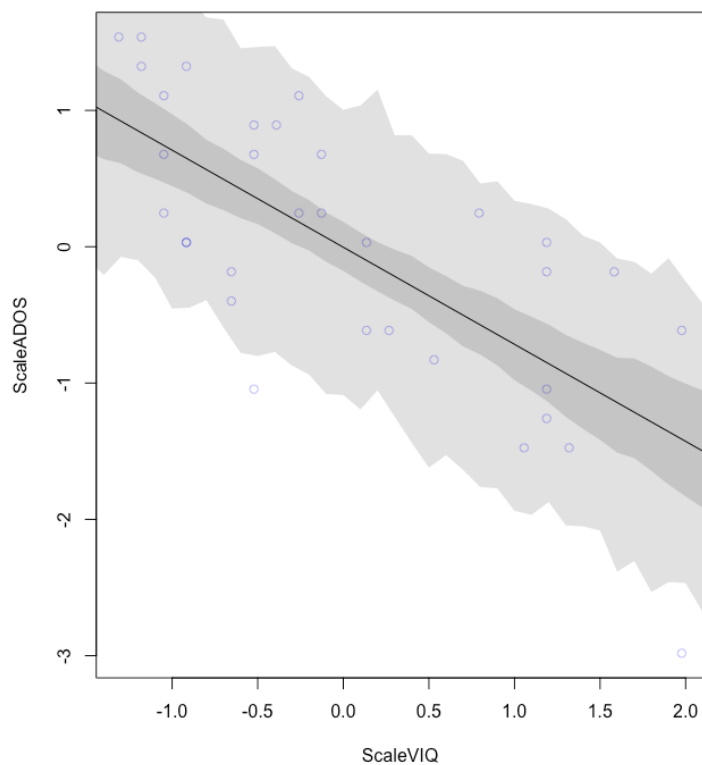


Figure 1 + 2 - Plots displaying the raw data, MAP line, HPDI region for line and PI region for simulated heights

1.2) Non-Verbal IQ and ADOS

Model for ADOS ~ Non-Verbal IQ

Mean StdDev 5.5% 94.5%

a 0.00 0.14 -0.22 0.22

b -0.57 0.14 -0.79 -0.35

sigma 0.80 0.10 0.65 0.96

There is once again a quite strong negative correlation between ADOS and non-verbal IQ. A change in 1 sd of non-verbal IQ (corresponding to 5.4 points on the scale) corresponds to a decrease in ADOS by 0.57 sd (corresponding to 2.6 points on the scale). There is only slightly more uncertainty in this estimate than in the one for verbal IQ, but their effects highly similar.

We used the scaled variables for the same reason as for verbal IQ.

The priors were once again very uninformative since we have very little prior information of what to expect.

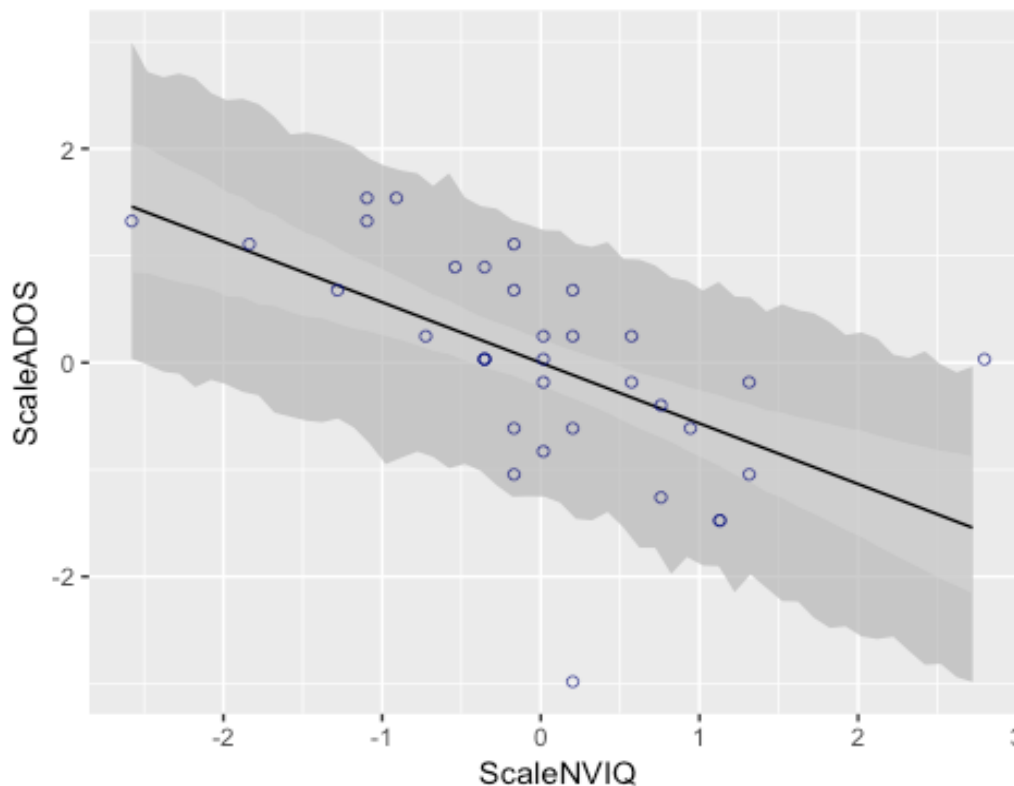


Figure 3 - displaying correlation between Non-Verbal IQ and ADOS.

1.3) Social IQ and ADOS

ADOS ~ Social IQ

	Mean	StdDev	5.5%	94.5%
a	0.00	0.12	-0.20	0.20
b	-0.66	0.13	-0.86	-0.46
sigma	0.73	0.09	0.59	0.87

Just as the other two models there is a negative relationship between ADOS and social IQ. When social IQ increases by 1 sd (corresponding to 11.3 on the scale) ADOS decreases by 0.66 sd (corresponding to 3.1 on the scale). The plots are not as nice for this variable as for the others. There seems to be more clustering on the low values of SIQ than for the other variables.

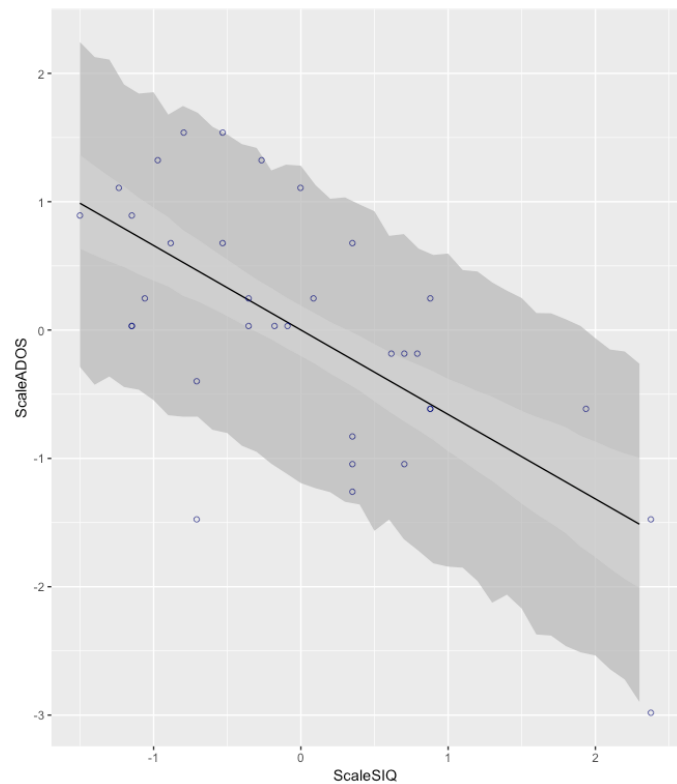


Figure 4 - Correlation between ADOS and Social IQ

As is obvious from the three plots displayed below, the relationship between the three variables and ADOS is very, very similar.

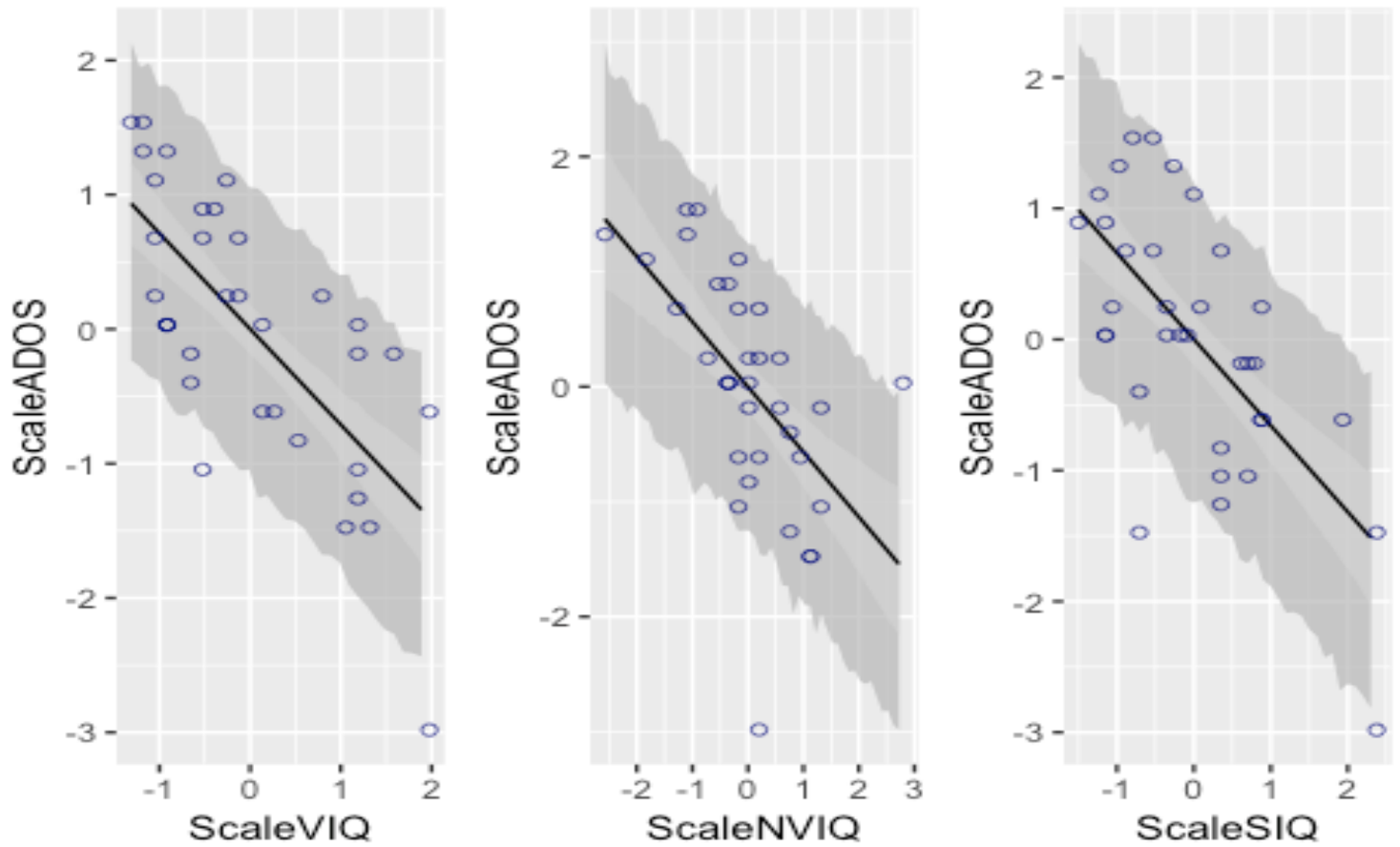


Figure 5

2) Do the different aspects of IQ account for different portions of the variance in ADOS?

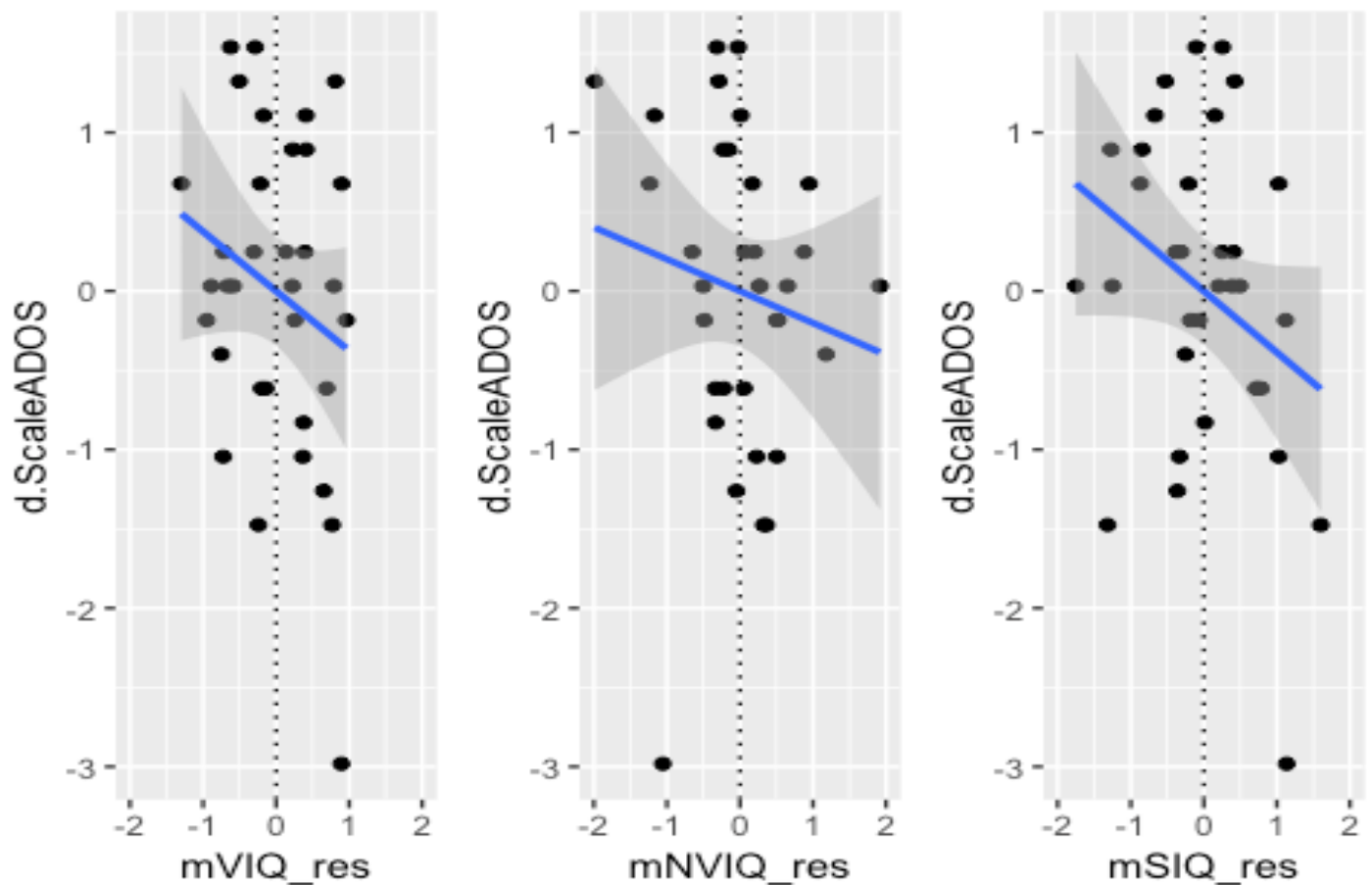


Figure 6 – plotting the residuals looking at IQ's vs. ADOS

By inspecting the plots, it seems non-verbal IQ does not contribute a lot that is not covered by verbal IQ or social IQ. Verbal IQ explains slightly more unique variance than non-verbal IQ, while Social IQ seems to be the one that explains the most unique variance. Overall, it seems like non-verbal IQ and verbal IQ explains much of the same variance, whereas social IQ has more unique variance.

All the variables have unique variance, however how much is very uncertain. The grey standard error shade shows that they might share most of each other's variance.

2.1) Does it make sense to have all IQ measures in the same model?

There seems to be some sense in including all the variables in the model. By inspecting the correlations between the variables, it is clear there is moderate to strong correlation between verbal IQ and non-verbal IQ (0.68), same degree between verbal IQ and social iq (0.61) but only a weak to moderate correlation

between social IQ and non-verbal IQ. This information combined with the residual plots suggests that each variable accounts for some unique variance. However, a lot of this will be shared, so it is expected that the beta values for each measure of IQ will be lower in the 'big' model than they are in the individual models. The betas are still expected to be some way from 0, as it seems they all have unique variance to account for.

2.2) Build the model and assess its quality.

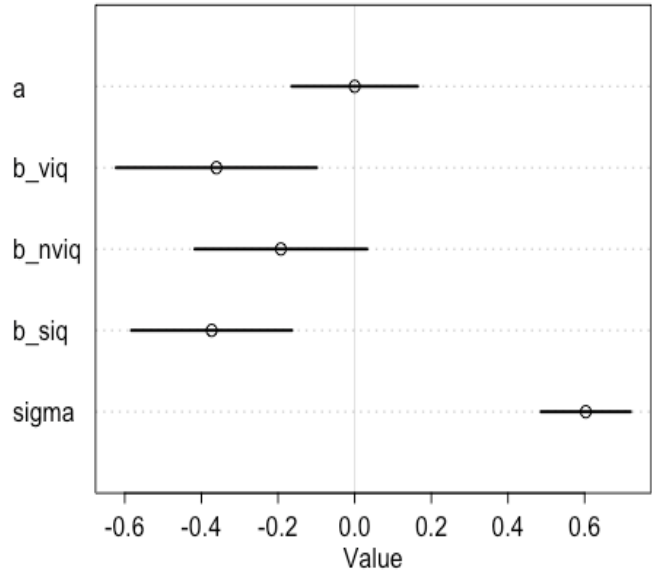


Figure 7 – Precis plot output

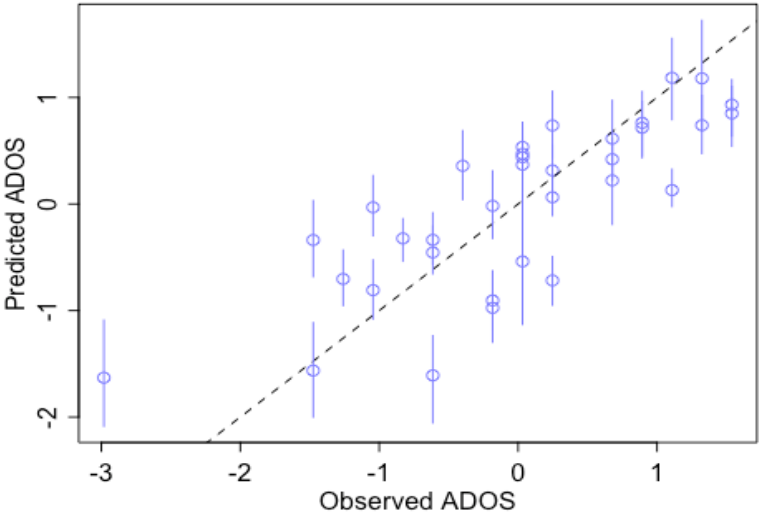


Figure 8 – predicted ADOS vs Observed ADOS

Mean StdDev 5.5% 94.5%

a	0.00	0.10	-0.16	0.16
b_viq	-0.36	0.16	-0.62	-0.10
b_nviq	-0.19	0.14	-0.42	0.03
b_siq	-0.37	0.13	-0.58	-0.16
sigma	0.60	0.07	0.49	0.72

Inspecting the table of coefficients and the plots graphically depicting them, non-verbal IQ explains the least unique variance as expected. Social IQ has the lowest variance of the three predictors which is probably due to it not being strongly correlated with non-verbal IQ. The model does not seem to consistently over or underestimate ADOS, however there is an issue with childID 14, who has a very low ADOS score which the model fails to predict.

3) Let's now include also the TD children. Does it make sense to ask whether IQ and ADOS are related? Motivate your answer. In any case, if you wanted to build a model to answer that question, which model would you build? Run the model, assess its quality, write a few lines interpreting the results.

It doesn't make much sense anymore since TD children practically all have ADOS scores of 0. This means the correlation between ADOS and any measures for the TD children will be close to 0. The model would likely still show a correlation between the IQ measures and ADOS, but the uncertainty will be much bigger and the slope flatter. I would build exactly the same model as in 2.2, but on the whole dataset (still at visit 1).

Model: $\text{ADOS} \sim \text{VerbalIQ} * \text{SocialIQ} * \text{Non-VerbalIQ}$

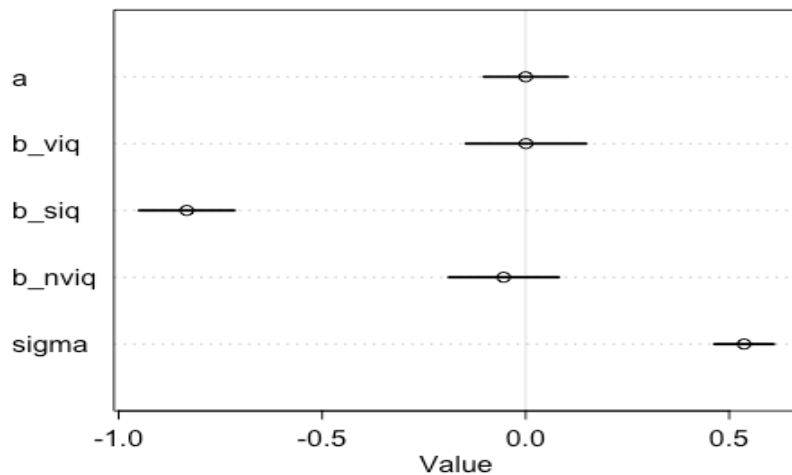


Figure 9 – *Precis* output

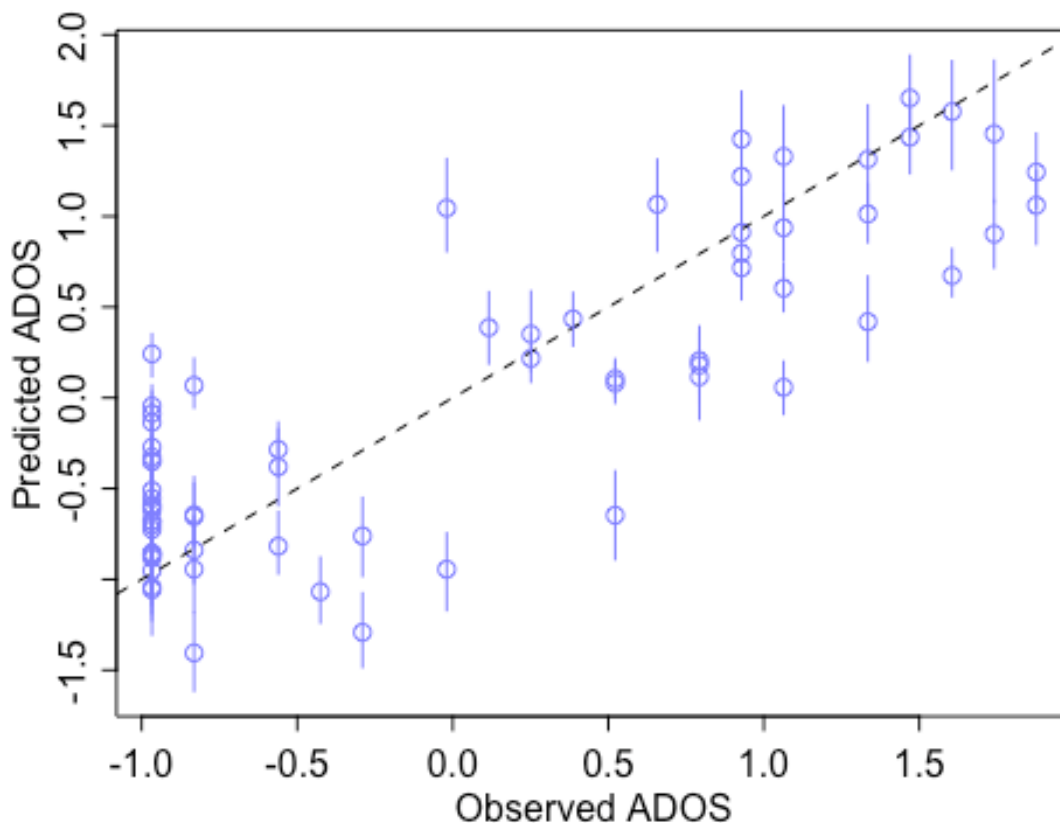


Figure 10 – Predicted ADOS vs Observed ADOS

Having TD children in the model very negatively affects predictive power. As expected, the TD children cluster together at the very bottom, skewing the model and creating very bad predictions; undershooting low values and overshooting higher values. Inspecting the betas reveals that verbal IQ and non-verbal IQ do not really explain any unique variance after accounting for the two other measures. Social IQ is highly influential, which is probably due to social IQ being one of the factors that separate TD and ASD children the most.

4.1) You have three scores for IQ, do they show shared variance? Is that the same in TD and ASD? What does that tell us about IQ?

The shared variance is very different in TD children and ASD children. All measures of IQ are quite correlated for ASD children (>0.5), but only non-verbal IQ and verbal IQ are significantly correlated for TD children (>0.5). Seems to suggest that (bullshit alert) IQ is one general measure for people with ASD, but that it is different dimensions/things for TD children.

4.2) You have explored the relation between IQ and ADOS. How do you explain that relation from a cognitive perspective? N.B. You can present alternative hypotheses.

The results are a bit confusing. For ASD children we can see that Social IQ & Verbal IQ are the strongest predictors of ADOS scores, Verbal IQ correlated with both Non-Verbal & Social IQ, but Social & Non-Verbal IQ are not very correlated. In TD children we see that Non-Verbal and Verbal IQ are highly correlated, but that Social IQ is less correlated from both of them. We can see Social IQ has an effect on ADOS for both ASD & TD children, despite Social IQ & Verbal IQ being more correlated in ASD children. This may be due to that ASD children may be more reliant on Verbal cues for their social interactions, whereas TD children may be more reliant on non-verbal interpretations (such as facial expressions) for social intelligence. We will argue that being better at reading facial expressions (social IQ) as well as understanding verbal and non-verbal cues (verbal and non-verbal IQ) facilitates good social interactions and therefore serves to decrease severity of symptoms of ASD (as measured in ADOS) in children diagnosed with ASD.