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202150369 04.11.22

Assignment 2: Meta Analysis

Part 1:

Simulating the data:

A new dataset is generated, which is defined by the requirements given in the assignment. A total of 100 studies should be simulated, with an average (mu) of 20 participants in each study, a standard deviation (sigma) of 10 and no lower than 10 participants in each study. The mean effect size should lie at 0.4 and the standard deviation by study at 0.4 and an error of 0.8.

Afterwards the simulation was set up in the shape of a for loop, which was generated by sampling with rnorm to simulate the study effects and rtnorm (which makes us able to truncate values) for participants, as it is stated that no less than 10 participants should be a part of each study. In the simulation a positive publication bias variable was also added. This ensures that we simulate close to the real world. We set the values to be 0.9 as the probability of a study being published if it was significant in the right way. Furthermore, some p-hacking was also included, as this often occurs in the real world. Three more studies were added to the simulated data through this.

Next, the model was being defined as :

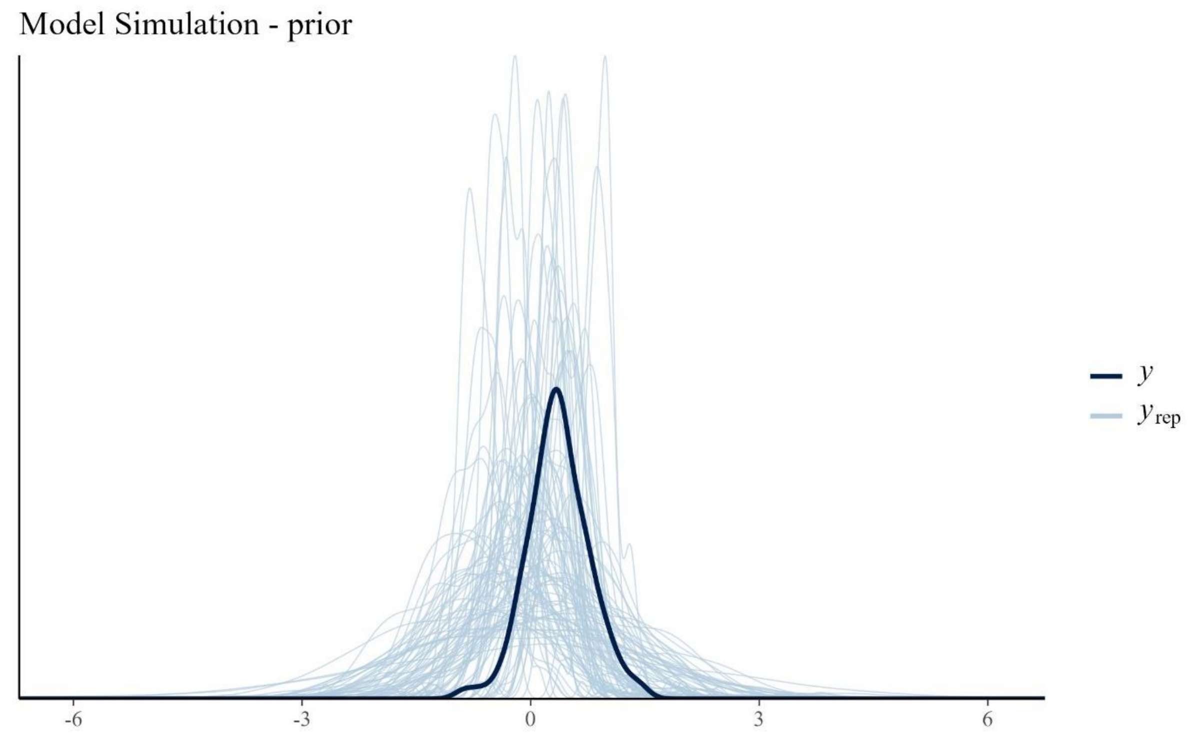
Model	**Description**
Model ← bf(StudyEffect | se(EffectSigma) ~ 1 + (1|Study))	The study effect as a distribution being dependent on the study and the individual differences per study.

Subsequently, the priors were being estimated and defined for the analysis process. The priors were estimated by looking at the distribution of the data, by viewing it as a histogram:

Intercept → Normal ~ (0, 0.4)

SD → Normal ~ (0, 0.8)

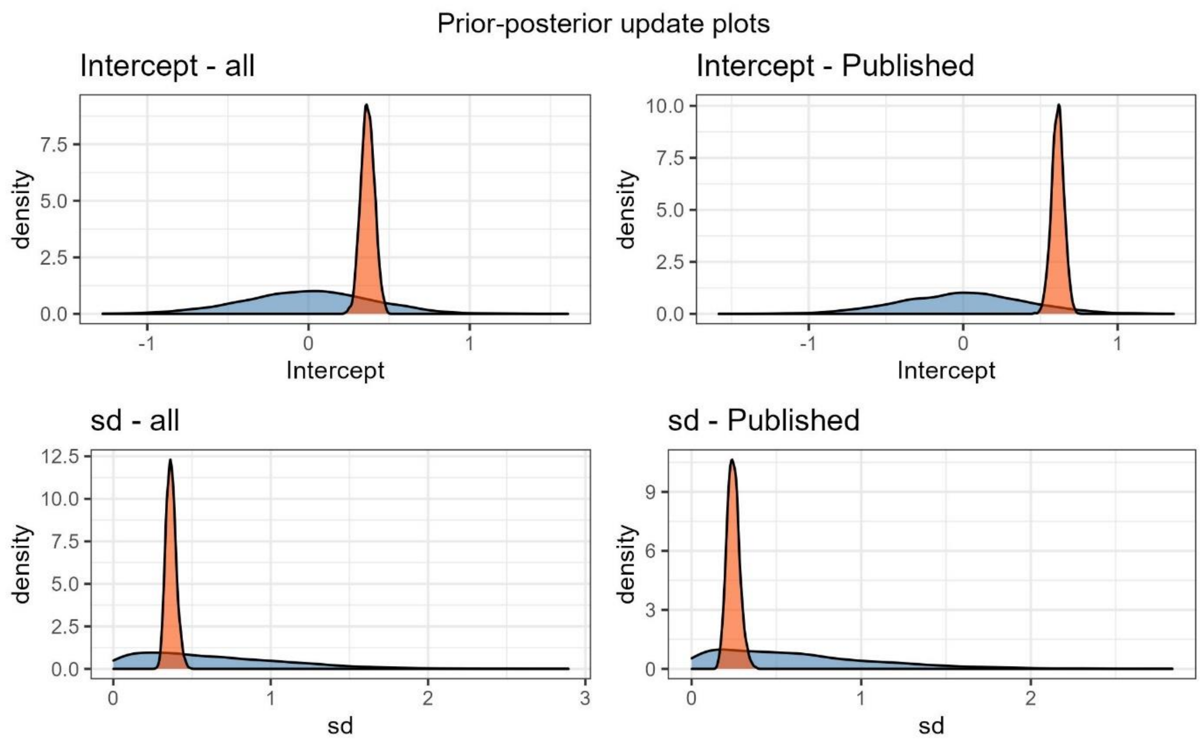
The model was then run with priors only and the priors were visualized in a plot.



Finally, the model was fitted to the real data. Before visualizing the data the output of the model was being updated to look at the positive publication bias, where publication bias was being set to “1” (published) to look at the extend of it.

Prior-Posterior update:

Following up, a prior-posterior update check was being conducted:



(Blue: Prior ; Red: Posterior)

The prior-posterior update check clearly shows that the model has been influenced by the data.

Furthermore, we can assess the difference between the model run on all of the data and the model run with the positive published studies. Looking at the intercept, the effect size seems to be larger than for the model run on all studies. This shows how publication bias can affect the overall outcome of a meta-analysis. The standard deviation also seems slightly broader for the positive published version, compared to the version containing all of the studies. This could be due to it being conducted on fewer studies.

All in all, the analysis and simulation show the effect of publication bias on meta analyses.

I don't know if we can conclude anything more from this plot… is there anything I could do to assess the difference further?

Part 2:

For part 2, the data was loaded, and a model was being formulated:

StudyEffect | se(EffectSigma) ~ 1 + (1|Study)

The aim was to create a model for effect size and the standard error for the standard deviation of the effect size predicted by the intercept, which is individual for each study.

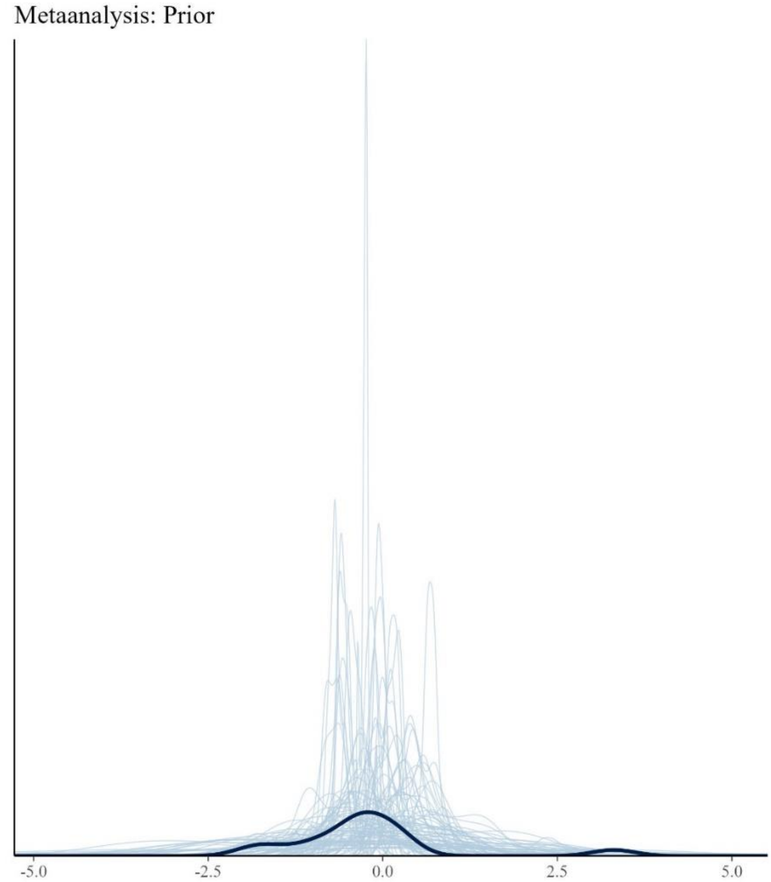
For the analysis, the effect sizes were being calculated in the form of Cohens D.

Following, priors were being set for the intercept and the standard deviation respectively:

Intercept → Normal ~ (0, 0.4)

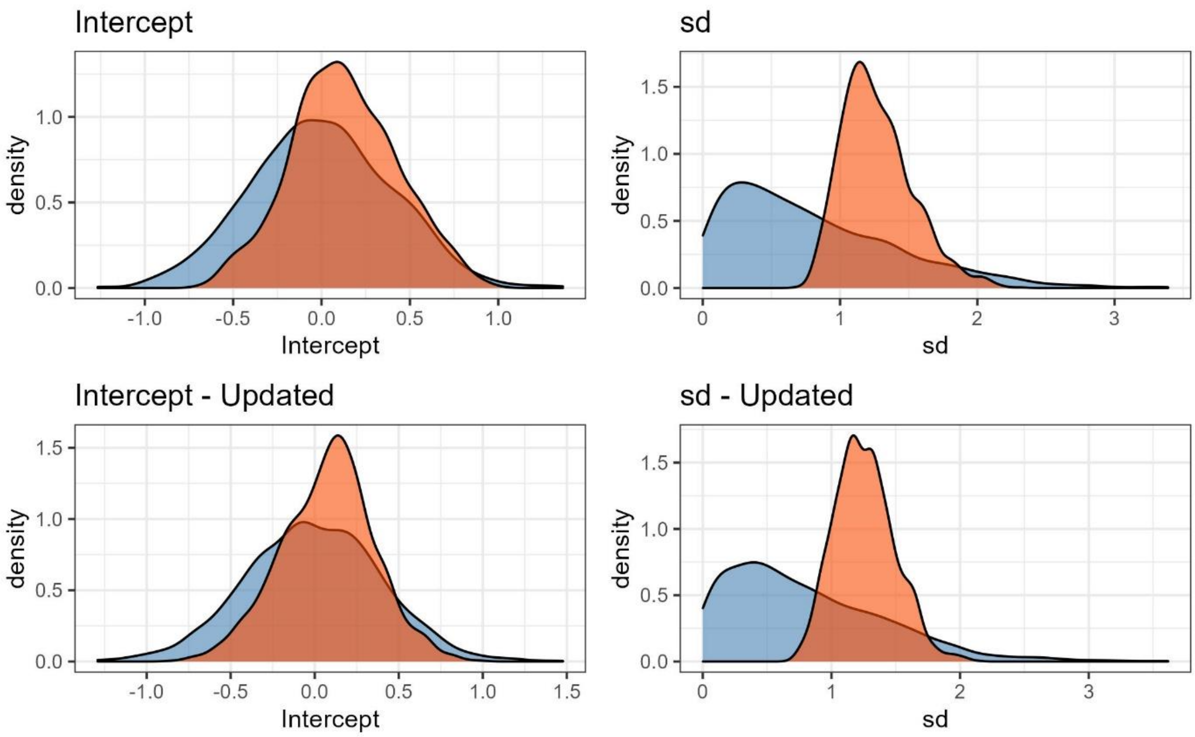
SD → Normal ~ (0, 1)

The model was run on the priors and then the prior distribution was visualized:



The same was done for the posterior distribution, while also updating the model.

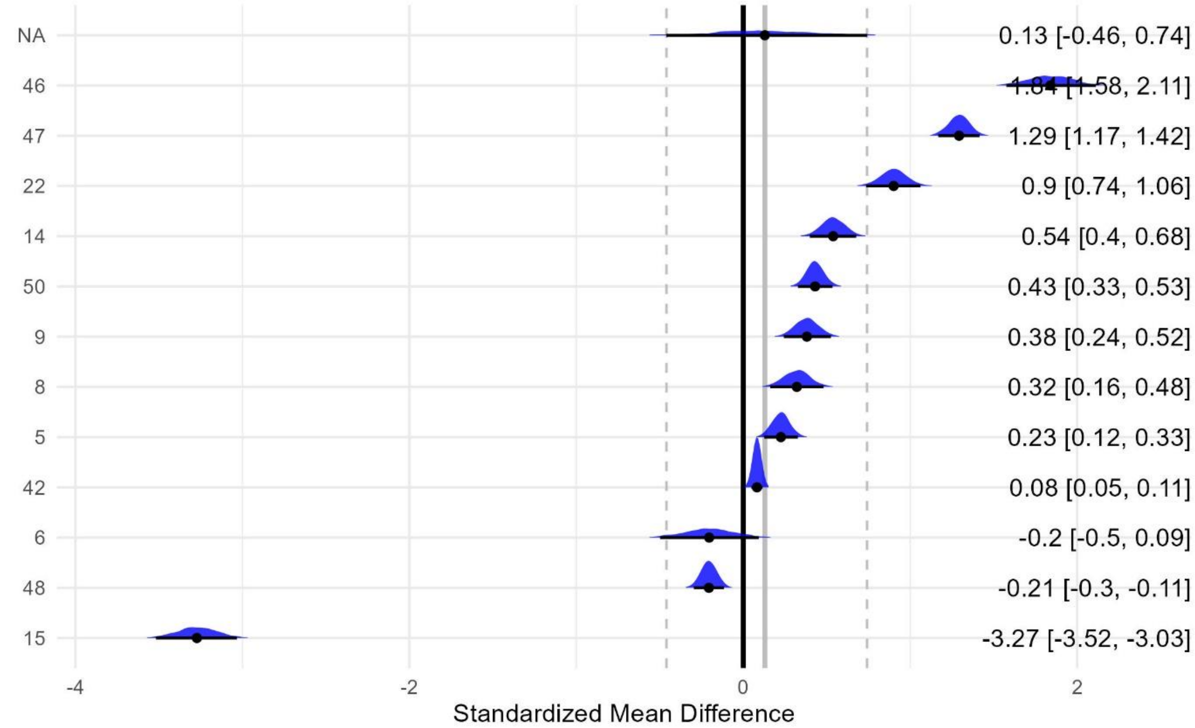
The prior-posterior update checks were visualized:



It can clearly be observed that the posterior distribution is "pointier" compared to the prior distribution. Furthermore, comparing the updated and the original model output does not show much of a difference. The distribution of the updated intercept posteriors seems to be wider than for the original. The priors seem to work fine as the posteriors do not push on any border of any priors.

Now, I do not get why we choose to update the model in this, if we don't add any other parameters etc. It would be nice if you could elaborate on that.

Lastly the standardized mean difference was visualized in a plot.



The standardized mean difference (smd) showcases the size of the intervention effect in each study of the meta-analysis, relative to the individual variability found in each study. The upmost row shows the the overall smd for all studies, which is at 0.13, where the grey line is centered for the sake of comparing the individual studies to the overall result. The dotted lines represent the 95% confidence interval of the mean result of the meta-analysis. On the right, the effect sizes of the studies can be seen, where the second uppermost study for example displays a large effect size of 1.84. Next to the effect size the confidence interval of the effect size for each study is displayed. The plot suggests a positive effect to be more probable, namely that the pitch of a person can be an indicator whether a person is affected by schizophrenia or not.

Publication bias:

A funnel plot was created that represents the number of trials/studies against their effect size. The more datapoints the more we would suspect that the points would converge around the true effect size. When looking for publication bias, we would expect an asymmetry of the datapoints/studies, which in a case of a positive publication bias, would be more drawn towards the positive side.

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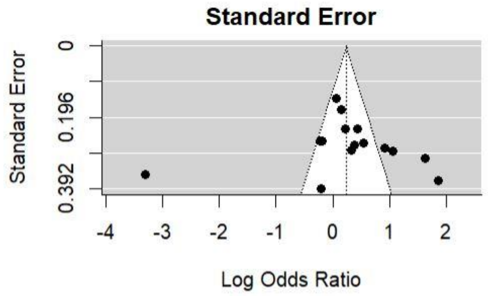
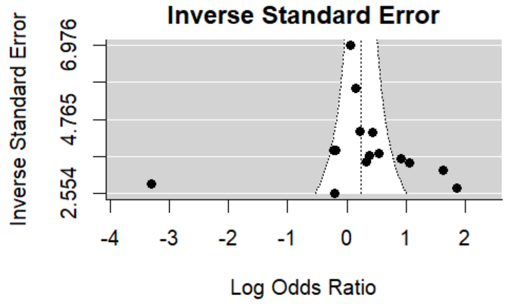




The figures suggest that there could be underlying publication bias as more datapoints are located on the positive side of the funnel and the datapoints are not distributed symmetrically. This has to be taken with a grain of salt though, as we have a very small number of studies and the funnel plot only allows for a visual interpretation of the data.

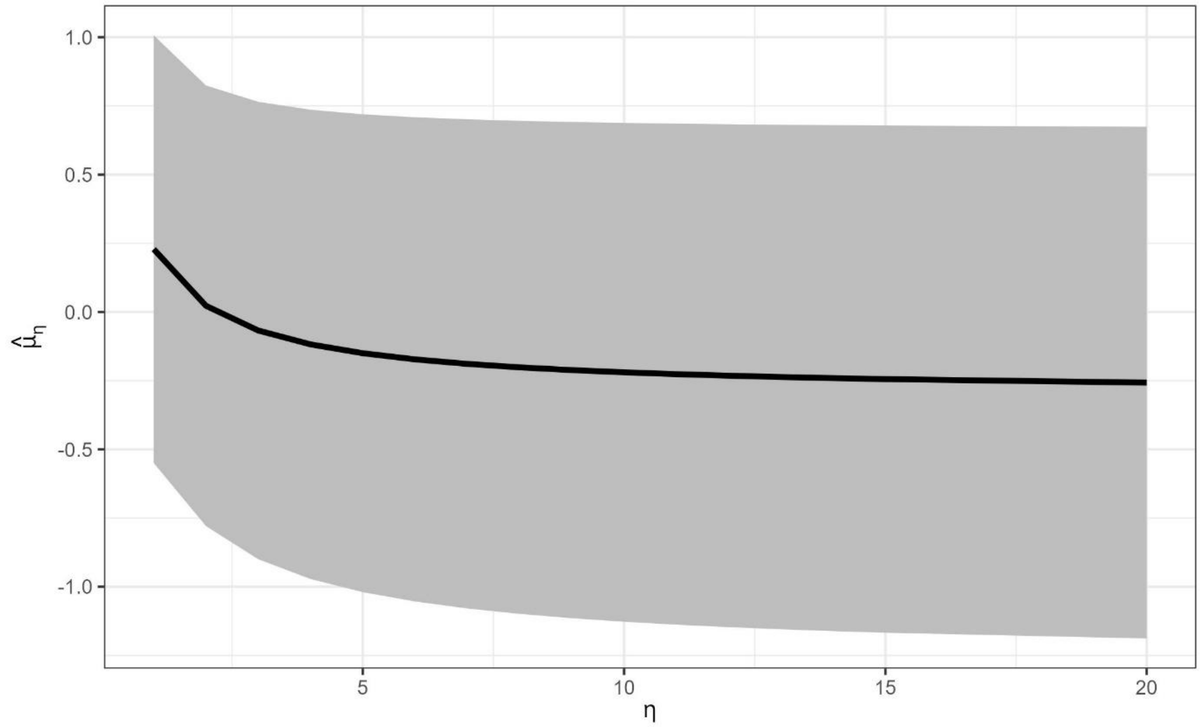
Here estimating the publication bias with eta was conducted. Eta is described as the number of times more affirmative studies would be published than studies who do not reaffirm the prior beliefs. Here the publication bias was assessed with a 3 and a 5 time more likelihood of being published.

Estimate	**SE**	**High**	**Low**	**p-val**	**Eta**
-0.067	0.342	0.764	-0.899	0.85	3
-0.15	0.35	0.719	-1.02	0.685	5

The results indicate that the results of this analysis are not significant, so they cannot tell for sure whether publication bias is affecting this meta-analysis

I don't get why the estimate is negative. Is it because there is no publication bias? The funnel plot suggests otherwise though…

Furthermore, a range of parameters for eta were tried out and visualized in a plot:



Again, I do not know what to do with this information. It seems like the results are only positive, if the eta is only slightly higher than 1, which again would account for only a minimal effect or even none.

General question: Which methods could I use to investigate publication bias further? I researched a lot but got very confused. I also tried different methods, but most of them did not work for me.