

Name _____

Psychology 5068
Hierarchical Linear Models
Homework 9
Due April 9, 2018

You will need the *metafor* package for this assignment.

The file, *phobia.csv*, contains data from 20 studies that reported the effectiveness of systematic desensitization for the treatment of arachnophobia. In these studies, participants were randomly assigned to either a treatment group or a waiting-list control group. At the conclusion of each study both groups were assessed for their fear of spiders using a behavioral measure and a report by the patient's spouse. The file contains the following variables:

study	An identifier for each study
weeks	Number of weeks of therapy
d_beh	Standardized mean difference comparing the treatment group to the wait-list control group using a behavioral measure (number of inches away from a tarantula that the patient was willing to stand at the conclusion of the study). Positive numbers indicate that the treatment group was able to approach the tarantula closer than the control group.
d_spouse	Standardized mean difference comparing the treatment group to the wait-list control group using a report from the patient's spouse about the patient's fear of spiders. Positive numbers indicate that spouses of treatment patients reported less fear than spouses of control patients.
r	The correlation between the behavioral measure and the spouse report.
n_tx	Number in the treatment group
n_con	Number in the control group

1. Carry out the following steps to create the additional variables needed for a meta-analysis:

- (a) Calculate the variance for each effect size:

$$V_j = \frac{n_{T_j} + n_{C_j}}{n_{T_j} n_{C_j}} + \frac{d_j^2}{2(n_{T_j} + n_{C_j})}$$

Name the new variances v_beh and v_spouse .

- (b) Calculate the covariance between the two effect sizes:

$$\sigma_{d_i d_j} = \left(\frac{1}{n_{T_i}} + \frac{1}{n_{C_i}} \right) r_{d_i d_j} + \frac{d_i d_j r_{d_i d_j}^2}{2(n_{T_i} + n_{C_i})}$$

Name this variable *cov*.

- (c) Rearrange the data file (call the new data file: *New_Phobia_Data*) so that it has two lines per study. The behavioral effect size should be on the first line; the spouse effect size on the second line. The effect sizes will now be in a single column; name it *d*. Two columns will be needed to hold the variance-covariance matrix for each study; name the two columns, *vc1* and *vc2*. These two columns will hold the variance and then the covariance for the behavior line and the covariance and then the variance for the spouse line. Create two dummy variables, called *d_b* and *d_s*. These should indicate whether the effect size on a line is for behavior or spouse report.
- (d) Create a block diagonal variance-covariance matrix for the collection of studies. Name this matrix, *BD*.

Use `head(New_Phobia_Data)` to show the first few lines of the new data file.

Use `head(BD)` to show the first few lines of the block diagonal matrix.

2. Begin by fitting an unconditional model (no dummy codes to indicate the type of outcome measure, but specify a random effects model that indicates DV is nested within study).
 - (a) Provide a forest plot. How many of the individual effect sizes are significantly different from 0?
 - (b) Provide a funnel plot. Effect sizes outside the confidence region suggest more heterogeneity than expected by sampling error. More effect sizes on one side than the other suggest publication bias. Is there evidence of either?
3. Now include the dummy codes for outcome type in a no-intercept model.
 - (a) Was treatment effective in reducing the fear of spiders as measured by the behavioral measure?
 - (b) On average, how much better off was a treatment participant compared to a control participant?
 - (c) Was treatment effective in reducing the fear of spiders as measured by the spouse reports?
 - (d) On average, how much better off was a treatment participant compared to a control participant?
 - (e) Was the effect size for spouse reports significantly different from the effect size for the behavioral measure?
 - (f) How highly related are the true effect sizes for behavior and spouse reports?
 - (g) Examine the funnel plot for this model and comment on what has changed compared to the unconditional model.
4. Now add the weeks of therapy variable as a moderator.
 - (a) Was treatment more effective the longer that patients were in treatment?
 - (b) Did length of therapy have different effects on the behavioral and spouse report effect sizes?
 - (c) Examine the funnel plot again. Any evidence of lingering heterogeneity that might be modeled with the inclusion of additional predictors?