Workshop on Multilevel Modeling 2 (Cross Classified Models)

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# Navigation

When this document is presented in slide show format, some slides may be long, and you may need to scroll down to see the full slide. In slide show format b makes text bigger, and s makes text smaller.

# Setup

. use "../multilevel-thinking/simulate-and-analyze-multilevel-data/simulated\_multilevel\_longit  
> udinal\_data.dta", clear

# Cross Classified Model

We can treat these random effects as being *cross classified*.

This might be useful if we had data where individuals lived in different countries at different times.

However, because id is in fact nested inside country, in this case, estimating the random effects as cross classified will be more time consuming, but will give us equivalent results.

## Standard (Less Computationally Efficient) Syntax

. \* mixed outcome t warmth physical\_punishment || \_all: R.country || \_all: R.id  
.   
. \* est store crossed1

The documentation notes that we can use a *much* more computationally efficient version of the above command, which is what we do in these notes. The user can verify that both versions of the command will produce equivalent results.

## Three Level Model

. mixed outcome t warmth physical\_punishment || country: || id: // 3 level w/ random intercep  
> ts only  
  
Performing EM optimization:   
  
Performing gradient-based optimization:   
  
Iteration 0: log likelihood = -28539.38   
Iteration 1: log likelihood = -28539.351   
Iteration 2: log likelihood = -28539.351   
  
Computing standard errors:  
  
Mixed-effects ML regression Number of obs = 9,000  
  
 Grouping information  
 ────────────────┬────────────────────────────────────────────  
 │ No. of Observations per group  
 Group variable │ groups Minimum Average Maximum  
 ────────────────┼────────────────────────────────────────────  
 country │ 30 300 300.0 300  
 id │ 3,000 3 3.0 3  
 ────────────────┴────────────────────────────────────────────  
  
 Wald chi2(3) = 2024.27  
Log likelihood = -28539.351 Prob > chi2 = 0.0000  
  
────────────────────┬────────────────────────────────────────────────────────────────  
 outcome │ Coefficient Std. err. z P>|z| [95% conf. interval]  
────────────────────┼────────────────────────────────────────────────────────────────  
 t │ .9929052 .0658231 15.08 0.000 .8638943 1.121916  
 warmth │ 1.046658 .0302211 34.63 0.000 .9874255 1.10589  
physical\_punishment │ -.9408357 .038315 -24.56 0.000 -1.015932 -.8657397  
 \_cons │ 51.22801 .3936058 130.15 0.000 50.45655 51.99946  
────────────────────┴────────────────────────────────────────────────────────────────  
  
─────────────────────────────┬────────────────────────────────────────────────  
 Random-effects parameters │ Estimate Std. err. [95% conf. interval]  
─────────────────────────────┼────────────────────────────────────────────────  
country: Identity │  
 var(\_cons) │ 3.676187 .9946793 2.163142 6.247558  
─────────────────────────────┼────────────────────────────────────────────────  
id: Identity │  
 var(\_cons) │ 8.923072 .4830621 8.024786 9.92191  
─────────────────────────────┼────────────────────────────────────────────────  
 var(Residual) │ 25.996 .4746206 25.08221 26.94308  
─────────────────────────────┴────────────────────────────────────────────────  
LR test vs. linear model: chi2(2) = 1339.33 Prob > chi2 = 0.0000  
  
Note: LR test is conservative and provided only for reference.  
  
.   
. est store threelevel // store random intercept model

## Cross Classified With Computationally Efficient Syntax

. mixed outcome t warmth physical\_punishment || \_all: R.country || id:  
  
Performing EM optimization:   
  
Performing gradient-based optimization:   
  
Iteration 0: log likelihood = -28539.38   
Iteration 1: log likelihood = -28539.351   
Iteration 2: log likelihood = -28539.351   
  
Computing standard errors:  
  
Mixed-effects ML regression Number of obs = 9,000  
  
 Grouping information  
 ────────────────┬────────────────────────────────────────────  
 │ No. of Observations per group  
 Group variable │ groups Minimum Average Maximum  
 ────────────────┼────────────────────────────────────────────  
 \_all │ 1 9,000 9,000.0 9,000  
 id │ 3,000 3 3.0 3  
 ────────────────┴────────────────────────────────────────────  
  
 Wald chi2(3) = 2024.27  
Log likelihood = -28539.351 Prob > chi2 = 0.0000  
  
────────────────────┬────────────────────────────────────────────────────────────────  
 outcome │ Coefficient Std. err. z P>|z| [95% conf. interval]  
────────────────────┼────────────────────────────────────────────────────────────────  
 t │ .9929052 .0658231 15.08 0.000 .8638943 1.121916  
 warmth │ 1.046658 .0302211 34.63 0.000 .9874255 1.10589  
physical\_punishment │ -.9408357 .038315 -24.56 0.000 -1.015932 -.8657397  
 \_cons │ 51.22801 .3936058 130.15 0.000 50.45655 51.99946  
────────────────────┴────────────────────────────────────────────────────────────────  
  
─────────────────────────────┬────────────────────────────────────────────────  
 Random-effects parameters │ Estimate Std. err. [95% conf. interval]  
─────────────────────────────┼────────────────────────────────────────────────  
\_all: Identity │  
 var(R.country) │ 3.676187 .9946793 2.163142 6.247558  
─────────────────────────────┼────────────────────────────────────────────────  
id: Identity │  
 var(\_cons) │ 8.923072 .4830621 8.024786 9.92191  
─────────────────────────────┼────────────────────────────────────────────────  
 var(Residual) │ 25.996 .4746206 25.08221 26.94308  
─────────────────────────────┴────────────────────────────────────────────────  
LR test vs. linear model: chi2(2) = 1339.33 Prob > chi2 = 0.0000  
  
Note: LR test is conservative and provided only for reference.  
  
.   
. est store crossed2 // store crossed effects result

# Nice Table of Results of Three Level and Cross Classified Model

. est table threelevel crossed2, ///  
> b(%9.3f) star stats(N ll chi2) ///  
> varwidth(20) modelwidth(15)  
  
─────────────────────┬──────────────────────────────────────────  
 Variable │ threelevel crossed2   
─────────────────────┼──────────────────────────────────────────  
outcome │  
 t │ 0.993\*\*\* 0.993\*\*\*   
 warmth │ 1.047\*\*\* 1.047\*\*\*   
 physical\_punishment │ -0.941\*\*\* -0.941\*\*\*   
 \_cons │ 51.228\*\*\* 51.228\*\*\*   
─────────────────────┼──────────────────────────────────────────  
lns1\_1\_1 │  
 \_cons │ 0.651\*\*\* 0.651\*\*\*   
─────────────────────┼──────────────────────────────────────────  
lns2\_1\_1 │  
 \_cons │ 1.094\*\*\* 1.094\*\*\*   
─────────────────────┼──────────────────────────────────────────  
lnsig\_e │  
 \_cons │ 1.629\*\*\* 1.629\*\*\*   
─────────────────────┼──────────────────────────────────────────  
Statistics │   
 N │ 9000 9000   
 ll │ -2.85e+04 -2.85e+04   
 chi2 │ 2024.272 2024.272   
─────────────────────┴──────────────────────────────────────────  
 Legend: \* p<0.05; \*\* p<0.01; \*\*\* p<0.001

# QUESTIONS???