

Unconditional Growth Curve Example

SPSS

In the above data set, codes for the time variable were 1, 2, and 3. But in order to interpret the intercept as the baseline value of the dependent variable, codes need to be 0, 1, and 2. My first line of syntax, therefore, fixes this.

```
recode time (1=0) (2=1) (3=2).
```

```
MIXED depress WITH time
/METHOD = REML
/PRINT = SOLUTION TESTCOV HISTORY
/FIXED = time | SSTYPE(3)
/RANDOM = INTERCEPT time | SUBJECT(rid) COVTYPE(UN).
```

Mixed Model Analysis

Information Criteria^a

| | |
|--------------------------------------|----------|
| -2 Restricted Log Likelihood | 4904.632 |
| Akaike's Information Criterion (AIC) | 4912.632 |
| Hurvich and Tsai's Criterion (AICC) | 4912.689 |
| Bozdogan's Criterion (CAIC) | 4934.836 |
| Schwarz's Bayesian Criterion (BIC) | 4930.836 |

The information criteria are displayed in smaller-is-better forms.

a. Dependent Variable: depress Summed CESD score.

Fixed Effects

Estimates of Fixed Effects^a

| Parameter | Estimate | Std. Error | df | t | Sig. | 95% Confidence Interval | |
|-----------|----------|------------|-----|--------|------|-------------------------|-------------|
| | | | | | | Lower Bound | Upper Bound |
| Intercept | 13.01008 | .6093059 | 233 | 21.352 | .000 | 11.8096311 | 14.2105370 |
| time | -1.91123 | .2889570 | 233 | -6.614 | .000 | -2.4805289 | -1.3419241 |

a. Dependent Variable: depress Summed CESD score.

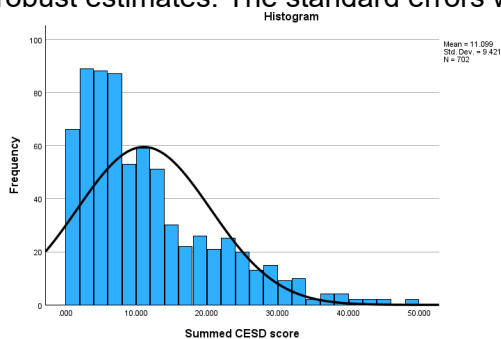
Covariance Parameters

Estimates of Covariance Parameters^a

| Parameter | Estimate | Std. Error | Wald Z | Sig. | 95% Confidence Interval | | |
|----------------------------------|----------|------------|-----------|--------|-------------------------|-------------|------------|
| | | | | | Lower Bound | Upper Bound | |
| Residual | 35.76270 | 3.3062627 | 10.817 | .000 | 29.8357311 | 42.8670804 | |
| Intercept + time (subject = rid) | UN (1,1) | 57.07111 | 8.5071837 | 6.709 | .000 | 42.6121780 | 76.4361578 |
| | UN (2,1) | -4.54025 | 3.4892977 | -1.301 | .193 | -11.3791517 | 2.2986439 |
| | UN (2,2) | 1.6567512 | 2.4514402 | .676 | .499 | .0911512 | 30.1128743 |

a. Dependent Variable: depress Summed CESD score.

The depression measure is pretty skewed in this data set, so I retested the model using GENLINMIXED to get the robust estimates. The standard errors were virtually identical, however.



```
*genlinmixed requires string id variable.
STRING id (A4).
COMPUTE id = STRING(rid, F4.0).
```

```
*time was a nominal variable, convert it to scale.
variable level time (scale).
```

```
GENLINMIXED
/DATA_STRUCTURE SUBJECTS=id
/FIELDS TARGET= depress
/TARGET_OPTIONS DISTRIBUTION=NORMAL LINK=IDENTITY
/BUILD_OPTIONS DF_METHOD=SATTERTHWAITE COVB=ROBUST
/FIXED EFFECTS= time USE_INTERCEPT=TRUE
/RANDOM EFFECTS=time USE_INTERCEPT=TRUE SUBJECTS=id
COVARIANCE_TYPE=UNSTRUCTURED.
```

Fixed Coefficients^a

| Model Term | Coefficient | Std. Error | t | Sig. | 95% Confidence Interval | |
|------------|-------------|------------|--------|-------|-------------------------|--------|
| | | | | | Lower | Upper |
| Intercept | 13.010 | .6080 | 21.398 | <.001 | 11.812 | 14.208 |
| time | -1.911 | .2883 | -6.628 | <.001 | -2.479 | -1.343 |

Probability distribution: Normal
 Link function: Identity

a. Target: Summed CESD score

```
R
> #change time codes to 0, 1, and 2
> mydata$time <- mydata$time - 1
>
> #see that data from this file are already in long form (disaggregated)
> View(mydata)
> #clear active frame from previous analyses
> rm(mydata)

> library(lme4)
> #unconditional growth curve model
> model <- lmer(depress ~ time + (time|rid), data = mydata, REML=TRUE)
> summary(model)
Linear mixed model fit by REML ['lmerMod']
Formula: depress ~ time + (time | rid)
Data: mydata
```

REML criterion at convergence: 4904.6

Scaled residuals:
 Min IQ Median 3Q Max
 -3.0095 -0.4859 -0.1303 0.3486 5.0355

Random effects:
 Groups Name Variance Std.Dev. Corr
 rid (Intercept) 57.071 7.555
 time 1.657 1.287 -0.47
 Residual 35.763 5.980
 Number of obs: 702, groups: rid, 234

Fixed effects:
 Estimate Std. Error t value
 (Intercept) 13.0101 0.6093 21.352
 time -1.9112 0.2890 -6.614

Correlation of Fixed Effects:
 (Intr)
 time -0.544
 > VarCorr(model)
 Groups Name Std.Dev. Corr
 rid (Intercept) 7.5545
 time 1.2871 -0.467
 Residual 5.9802

Profile variance tests with `rand()` from the `lmerTest` package using full ML could be added to test the random effects.

```
> library(lmerTest)
> rand(model)
ANOVA-like table for random-effects: single term deletions
```

```
Model:
depress ~ time + (time | rid)
npars logLik AIC LRT Df Pr(>Chisq)
<none> 6 -2452.3 4916.6
time in (time | rid) 4 -2453.3 4914.7 2.0743 2 0.3545
```

Use `MLMusingR` to get Robust standard errors

```
> #get robust estimates
> library(MLMusingR)
> robust_mixed(model)
```

Standard error type = CR2
 Degrees of freedom = Satterthwaite

```
Estimate mb.se robust.se t.stat df Pr(>t)
(Intercept) 13.010 0.609 0.609 21.352 233 <0.0000000000000002 ***
time -1.911 0.289 0.289 -6.614 233 <0.0000000000000002 ***
---
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

HLM

Summary of the model specified

Level-1 Model

$$DEPRESS_{ij} = \beta_{0j} + \beta_{1j} * (TIME_{ij}) + r_{ij}$$

Level-2 Model

$$\beta_{0j} = \gamma_{00} + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + u_{1j}$$

Mixed Model

$$DEPRESS_{ij} = \gamma_{00}$$

$$+ \gamma_{10} * TIME_{ij} + u_{0j} + u_{1j} * TIME_{ij} + r_{ij}$$

Iterations stopped due to small change in likelihood function

$$\sigma^2 = 35.76270$$

τ

INTRCPT1, β_0 57.07111 -4.54025

TIME, β_1 -4.54025 1.65675

τ (as correlations)

INTRCPT1, β_0 1.000 -0.467

TIME, β_1 -0.467 1.000

| Random level-1 coefficient | Reliability estimate |
|----------------------------|----------------------|
| INTRCPT1, β_0 | 0.657 |
| TIME, β_1 | 0.085 |

The value of the log-likelihood function at iteration 2 = -2.452316E+003

Final estimation of fixed effects:

| Fixed Effect | Coefficient | Standard error | t-ratio | Approx. d.f. | p-value |
|---------------------------|-------------|----------------|---------|--------------|---------|
| For INTRCPT1, β_0 | | | | | |
| INTRCPT2, γ_{00} | 13.010084 | 0.609306 | 21.352 | 233 | <0.001 |
| For TIME slope, β_1 | | | | | |
| INTRCPT2, γ_{10} | -1.911226 | 0.288957 | -6.614 | 233 | <0.001 |

Final estimation of fixed effects (with robust standard errors)

| Fixed Effect | Coefficient | Standard error | t-ratio | Approx. d.f. | p-value |
|---------------------------|-------------|----------------|---------|--------------|---------|
| For INTRCPT1, β_0 | | | | | |
| INTRCPT2, γ_{00} | 13.010084 | 0.608003 | 21.398 | 233 | <0.001 |
| For TIME slope, β_1 | | | | | |
| INTRCPT2, γ_{10} | -1.911226 | 0.288339 | -6.628 | 233 | <0.001 |

Final estimation of variance components

| Random Effect | Standard Deviation | Variance Component | d.f. | χ^2 | p-value |
|-------------------|--------------------|--------------------|------|-----------|---------|
| INTRCPT1, u_0 | 7.55454 | 57.07111 | 233 | 679.19342 | <0.001 |
| TIME slope, u_1 | 1.28715 | 1.65675 | 233 | 254.58802 | 0.159 |
| level-1, r | 5.98019 | 35.76270 | | | |

Statistics for current covariance components model

Deviance = 4904.631570

Number of estimated parameters = 4

Note: depending on how the original .mdm file is set up on HLM, the notation in the output may look different. π for level-1 and β for level-2 fixed effects are used if you choose to set up the .mdm file for repeated measures instead of nested within groups, "longitudinal (occasions within individual)" in the Make MDM dialog box.