Specifying Linear Mixed Models in R, Stata, SPSS, SAS, and JMP

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The following table provides the basic syntax to perform mixed models in Stata, R, SAS, SPSS and JMP. There are some minor differences in the estimation procedures between the five programs. For instance, Stata will estimate the random effects using maximum likelihood instead of restricted maximum likelihood. When estimating random slopes, JMP will center the variable. However, these subtle differences can be overcome by using options. Also, some of the software have limitations calculating certain models: current editions of JMP and R's nlme package cannot estimate generalized linear mixed models.

The following table uses the options to produce identical results among the five programs. For ease, we model a continuous dependent variable with one independent variable. Let **x** represent an independent variable, **y** the dependent variable, and both $\mathbf{z}_1$ and, $\mathbf{z}_2$ be random effects.

R

modeltype	code
Random Intercept	`lmer(y~x+(1|z1)) [lme4]` `lme(y~x, random=~1|z1) [nlme]`
Nested Random Effects (**z2** nested in **z1**)	`lmer(y~x+(1|z1/z2)) [lme4]` `lme(y~x, random=~1|z1/z2) [nlme]`
Crossed Random Effects	`lmer(y~x(1|z1)+(1|z2)) [lme4]`
Random intercept and random slope	`lmer(y~x+(1+x|z1)) [lme4]`

Stata

modeltype	code
Random Intercept	`mixed y x || z1, reml`
Nested Random Effects (**z2** nested in **z1**)	`mixed y x || z1:||z2,reml`
Crossed Random Effects	`mixed y x|| _all: R.z1 || _all: R.z2, reml` `mixed y x|| _all: R.z1 |.z2:, reml`
Random intercept and random slope	`mixed y x || z1: x, covariance(unstructured) reml`

SPSS

modeltype	code

Random Intercept	`MIXED y WITH x`
	`/FIXED=x| SSTYPE(3)`
	`/METHOD=REML`
	`/RANDOM=INTERCEPT | SUBJECT(z1) COVTYPE(VC).`
	
	`MIXED y WITH x BY z1`
	`/FIXED=x | SSTYPE(3)`
	`/METHOD=REML`
	`/RANDOM=z1 | COVTYPE(VC).`

Nested Random Effects (**z2** nested in **z1**)	`MIXED y WITH x BY z1 z2`
	`/FIXED=x | SSTYPE(3)`
	`/METHOD=REML`
	`/RANDOM= z1 z2(z1) | COVTYPE(VC).`

Crossed Random Effects	`MIXED y WITH x BY z1 z2`
	`/FIXED=x| SSTYPE(3)`
	`/METHOD=REML`
	`/PRINT=SOLUTION`
	`/RANDOM= z1 z2| COVTYPE(VC).`

Random intercept and random slope	`MIXED y With x`
	`/FIXED=x | SSTYPE(3)`
	`/METHOD=REML`
	`/PRINT=SOLUTION`
	`/RANDOM=INTERCEPT x | SUBJECT(z1) COVTYPE(UN).`

SAS

modeltype	code

Random Intercept	`proc mixed data= data;`
	`class` **`z1`**`;`
	`model` **`y`**`=`**`x`** `/ solution;`
	`random intercept/ subject=`**`z1`**`;`
	`run;`
	
	`proc mixed data=data;`
	`class` **`z1`**`;`
	`model` **`y`**`=`**`x`** `/solution;`
	`random` **`z1`**`;`
	`run;`

Nested Random Effects (**z2** nested in **z1**)	`proc mixed data=data;`
	`class` **`z1 z2`**`;`
	`model` **`y`**`=`**`x`** `/ solution;`
	`random` **`z1 z2`**`;`
	`run;`

Crossed Random Effects	`proc mixed data=data;`
	`class` **`z1 z2`**`;`
	`model` **`y`**`=`**`x`** `/ solution;`
	`random intercept/ subject=`**`z1`**`;`
	`random intercept/ subject=`**`z1`**`;`
	`run;`

Random intercept and random slope	`proc mixed data=data;`
	`class` **`z1`**`;`
	`model` **`y`**`=`**`x`** `/ solution;`
	`random intercept/ subject=`**`z1`** `type=UN; run;`

JMP

modeltype	roles	code
Random Intercept	Role Variable : Y=**y** Model Effects : **x** **z1**&Random	Click **Analyze > Fit Model** Add **y**, **x**, and **z1** Select **z1** and click **Attributes > Random Effects**
Nested Random Effects (**z2** nested in **z1**)	Role Variable : Y=**y** Model Effects : **x** **z2**[**z1**]&Random **z1**&Random	Click **Analyze > Fit Model** Add **y**, **x**, **z1**, and **z2** Select, **z2** from Model Effects and **z1** from Column and then click "Nest" Select **z2**[**z1**] and z1 from Model effects, and then click **Attributes > Random Effects**
Crossed Random Effects	Role Variable : Y=**y** Model Effects : **x** **z1**&Random **z2**&Random	Click **Analyze > Fit Model** Add **y x**, **z1**, and **z2** Select **z1**, and **z2** and click **Attributes > Random Effects**
Random intercept and random slope	Role Variable: Y=**y** Fixed effects: **x** Random effects: Intercept[**z1**]&Random coefficients(1) **x**[**z1**]&Random coefficients(1)	Click Analyze > Fit Model Under **Personality** (at upper right), choose **mixed model** Click the **red triangle** next to the title, Model Specification, and *uncheck* **Center Polynomials** Under Fixed Effects, add **x** In **Random Effects**, add **x** and then select **z1** from **Columns** and **x** from **Random Effects** and click "Nest Random Coefficients"