Fitting the random intercept model in SPSS

| | Name | Туре | Wid | Dec | Label | Values |
|---|----------|---------|-----|-----|-------------------------------------|-----------------|
| 1 | cluster | Numeric | 1 | 0 | Socioeconomic profile of the school | {1, low} |
| 2 | teacher | Numeric | 1 | 0 | Teacher | None |
| 3 | sid# | Numeric | 1 | 4 | Student ID | None |
| 4 | year | String | 7 | 0 | Year | None |
| 5 | sex | Numeric | 1 | 4 | Sex | {1.0000, male}. |
| 6 | att_scho | Numeric | 1 | 4 | Attitude toward School | None |
| 7 | att_scnt | Numeric | 1 | 4 | Attitude toward Scientists | None |
| 8 | sciences | Numeric | 1 | 4 | Science Selfconcept | None |
| 9 | att_scie | Numeric | 1 | 4 | Attitude toward Science | None |

The data (In Variable View)

The research Question:

Are the students' attitudes toward school different between boys and girls?

The Model:

Since we sampled teachers, and then surveyed their students, students within the same class will have correlated attitudes. A random intercept model can be used to address this dependency.

$$att_scho_{i,j} = \beta_0 + \beta_1 * sex_{i,j} + b_j + \varepsilon_{i,j}$$

$$b_j \stackrel{iid}{\sim} Normal(0, \sigma_2^2)$$

$$\varepsilon_{ij} \stackrel{iid}{\sim} Normal(0, \sigma_1^2)$$

i indexes teachers. *j* indexes teachers.

This model separates out the variation due to teacher differences, and the variation due to individual student differences.

Fitting the model:

1. Select Analyze>Mixed Models>linear.

| | 🚰 *PICSES.sav [DataSet1] - SPSS Data Editor | | | | | | | |
|-------------|--|----------|---------|---|-----------------|--|--|--|
| File | File Edit View Data Transform Analyze Graphs Utilities Add-ons Window Help | | | | | | | |
| 😕 🖶 🎒 📴 🔶 🍝 | | | . 🔶 🐜 | Reports | | | | |
| | | Name | Туре | Compare Means 🔹 Label | Values | | | |
| | 1 | cluster | Numeric | General Linear Model 🔹 🕨 file of the school | {1, low} | | | |
| | 2 | teacher | Numeric | Generalized Linear Models 🔸 | None | | | |
| | 3 | sid# | Numeric | Mixed Models Linear | None | | | |
| | 4 | year | String | Correlate | None | | | |
| | 5 | sex | Numeric | | {1.0000, male}. | | | |
| | 6 | att_scho | Numeric | | None | | | |
| | - 7 | att_scnt | Numeric | Data Reduction | None | | | |
| | 8 | sciences | Numeric | Scale 🕨 🕨 pt | None | | | |
| | 9 | att_scie | Numeric | Nonparametric Tests 🔹 🕨 ence | None | | | |
| | 10 | | | Time Series | | | | |
| | 11 | | | Survival 🕨 | | | | |
| | 12 | | | Multiple Response | | | | |
| | 13 | | | Quality Control | | | | |
| | 14 | | | ROC Curve | | | | |
| | 15 | | | | | | | |

If you do not have this option, you do not have the Advance Regression Models add-on pack installed.

2. Move both your students and teachers into the Subjects box. Leave the Repeated box blank. Press continue.

| 🗆 Linear Mixed Models: Specify Subjects and Repeated 🛛 🛛 🔀 | | | | | | |
|--|-----------------------------|----------|--|--|--|--|
| Click Continue for models with Specify Subject variable for m Specify both Repeated and S residuals within the random eff | Continue Reset Cancel | | | | | |
| Socioeconomic profile o Control of the sex [year] Control of the sex [sex] Control of the sex | Subjects: | Help | | | | |
| | • | | | | | |
| Repeated Covariance Type: | Diagonal | ~ | | | | |

3. Move att_scho into the dependant variable box. Move sex into the factor box. Anything in the factor box is automatically dummy coded. In general put categorical variables into the factor box, and continuous ones into the Covariate box.

| 🗖 Linear Mixed Models | | | |
|--|-----------|--|--|
| Socioeconomic profile of th Teacher [teacher] Student ID [sid#] Year [year] Attitude toward Scientists [a Science Selfconcept [scientiate of the second science [at the second | • | Dependent Variable: Attitude toward School [att_scho Factor(s): Sex [sex] | OK Paste Reset Cancel Help |
| | Þ | Covariate(s): | |
| Fixed Random | Estimatio | Residual Weight: | Save |

4. Click on the 'Fixed...' button. Select sex(F), then click 'add'. This forms the $\beta_0 + \beta_1 * sex_{i,j}$ part of the model. Then click continue.

| Linear Mixed Models Nominal Nominal | |
|--|--------------|
| Image: Socioeconomic profile of the | |
| Socioeconomic profile of th Dependent Variable: OK Nominal Teacher [teacher] Image: Comparison of the state of the s | |
| Social control in the province of the pro | |
| Student ID [sid#] | |
| | |
| | |
| Attitude toward Scientists Ia | |
| Science Selfconcept [scien] | |
| Attitude toward Science Let | |
| Linear Mixed Models: Fixed Effects | \mathbf{X} |
| | _ |
| Fixed Effects | |
| Build terms Build nested terms | |
| | |
| Factors and Covariates: Model: | |
| sex(F) | |
| | |
| | |
| Factorial 🗸 | |
| | |
| Fixed | |
| | |
| | - |
| Bu* (Within) Clear Term Add Bemove | |
| | |
| Build Term: | |
| | |
| | |
| | |
| Continue Intercept Sum or squares: Type III Y Continue Cancel Hel | |

5. Next we will form the random effects (b_j) . Click 'Random...'. Now select 'teacher', and move it to the Combinations box. Check the 'Include Intercept' box. Click Continue.

| ID | Linear Mixed Models: Random Effects 🛛 🛛 🔀 | | | | | |
|-------------------------------|---|----------------------|---------------------|------|--|--|
| Linear Mixed Models | Random Effect 1 of 1 | | | Next | | |
| Socioeconomic profile of th | Covariance Type: | Variance Components | * | | | |
| Teacher [teacher] | - Random Effects | | | | | |
| Student ID [sid#] | Build terms | O Build nested terms | 🗹 Include Intercept | | | |
| Attitude toward Scientists [a | Factors and Covariates: | Model: | | | | |
| Science Selfconcept [scier | sex(F) | | | | | |
| 💑 Attitude toward Science [at | | | | | | |
| | | Factorial | | | | |
| | By* (Within) | Clear Term Add | Remove | | | |
| | Build Term: | | | | | |
| | - Subject Groupings | | | | | |
| | Subjects: | Combinations: | | | | |
| Fixed Random | | Teacher (teach | her] | | | |
| | | | Continue Cancel | Help | | |

6. Lastly, Click on 'Statistics...', and the check the 'Parameter estimates' box. Chick continue, the OK.

| 🗖 Linear Mix | Linear Mixed Models: Statistics 🛛 🛛 🔀 | |
|---|---|--|
| Socioec Student Student Attitude Attitude | Summary Statistics Continue Descriptive statistics Cancel Case Processing Summary Help Model Statistics Help Parameter estimates Tests for covariance parameters Correlations of parameter estimates Covariances of parameter estimates Covariances of random effects Covariances of residuals Contrast coefficient matrix Statistics | OK Paste Reset Cancel Help |
| Fixed | Random Estimation Statistics EM Means | Save |

The Output

Output:

Type III Tests of Fixed Effects(a)

| Source | Numerator df | Denominato r df | F | Sig. |
|---------------|-----------------|--------------------|---------|------|
| Intercep t | 1 | 36.963 | 930.016 | .000 |
| sex | 1 | 1057.205 | 50.358 | .000 |

a Dependent Variable: Attitude toward School.

This table tests all of the variables that were put into the Fixed effects in step 4. We see that sex is significantly related to school attitudes. The F statistic for this test is: F(1,1057.205) = 50.358. And the p-vale is listed under sig. p<.001.

But, did boys or girls have better attitudes toward school? We can look at the parameter estimates to find out.

Output:

| Estimates of Fixed Effects ^b | | | | | | | |
|---|----------|------------|----------|--------|------|-------------|---------------|
| | | | | | | 95% Confid | ence Interval |
| Parameter | Estimate | Std. Error | df | t | Sig. | Lower Bound | Upper Bound |
| Intercept | 1.158292 | .039578 | 76.096 | 29.266 | .000 | 1.079466 | 1.237117 |
| [sex=1.0000] | 308764 | .043510 | 1057.205 | -7.096 | .000 | 394140 | 223387 |
| [sex=2.0000] 0ª 0 | | | | | | | |
| a. This parameter is set to zero because it is redundant. | | | | | | | |

b. Dependent Variable: Attitude toward School.

Sex was coded 1=male, 2=female. We see here that boys, on average had .308764 point lower score on the attitude scale, implying that they had a more negative view of school.

Next the procedure prints out information regarding our random effect, and the residual error.

Output:

Covariance Parameters

Estimates of Covariance Parameters(a)

| | | Std. |
|------------------|----------|---------|
| Parameter | Estimate | Error |
| Residual | .504507 | .022122 |
| Intercept Varian | ce | |
| [subject = | .023269 | .009585 |
| teacher] | | |

a Dependent Variable: Attitude toward School.

These estimates are the approximate values of σ_1^2 and σ_2^2 . No significance tests should be done on these estimates. There is no easy or standard way of determining the significance of Covariance parameters, and none of the usual software does it correctly. Though SPSS has an option to perform tests of significance on covariance parameters, these tests are incorrect. The reason why is a bit technical, but basically the estimate of the standard error breaks down when the Covariance parameter is 0, and thus can not be used in significance testing. Parametric bootstrapping can overcome this difficulty.