

Plotting Slopes Following an HLM Analysis

R, C, Gardner
 Department of Psychology

Consider an HLM analysis that has one level 1 predictor (fmot) and one level 2 predictor (attclas), representing student motivation (fmot) and class attitude (attclas). The level 1 equation would be:

$$Y_{ij} = \beta_{0j} + \beta_{1j}(fmot_{ij} - \overline{fmot}_{.j}) + r_{ij}$$

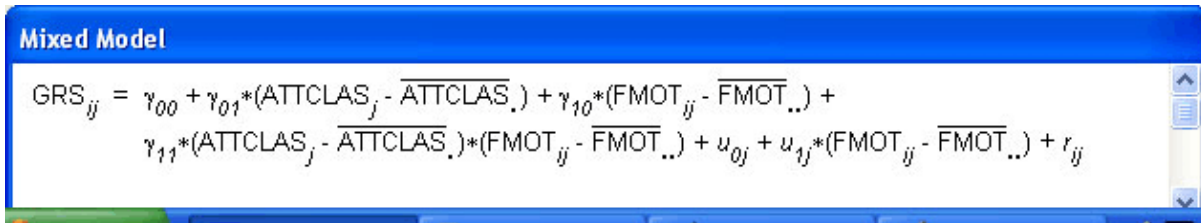
and the two level 2 equations would be:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(\overline{attclas}_j - \overline{attclas}) + \mu_{0j}$$

and

$$\beta_{1j} = \gamma_{10} + \gamma_{11}(\overline{attclas}_j - \overline{attclas}) + \mu_{1j}$$

Running this through HLM would result in the formal equation:



Running sample data for five groups through HLM presents the following results:

Final estimation of fixed effects:

Fixed Effect	Coefficient	Standard Error	T-ratio	d.f.	Approx. P-value

For INTRCPT1, B0					
INTRCPT2, G00	55.412869	1.998498	27.727	4	0.000
ATTCLAS, G01	-8.430881	3.202816	-2.632	4	0.056
For FMOT slope, B1					
INTRCPT2, G10	2.905690	0.780974	3.721	4	0.033
ATTCLAS, G11	-0.067059	1.279706	-0.052	4	0.961

Final estimation of variance components:

Random Effect		Standard Deviation	Variance Component	df	Chi-square	P-value
INTRCPT1, U0		3.71409	13.79450	4	9.62274	0.047
FMOT slope, U1		1.56442	2.44741	4	16.17302	0.003
level-1, R		14.62204	213.80410			

The first table presented above indicates that the mean intercept over all groups is 55.413, that there is a near-significant ($p < .056$) negative linear relationship between the intercepts and attclas over the 5 groups (-8.431), and that the mean slope of the dependent measure (GRS) on fmot (2.906) was significantly different from 0 ($p < .033$). The second table shows that the variability of both the intercepts and slopes over the five groups was significantly greater than 0 (variances = 13.795 ($p < .047$) and 2.447 ($p < .003$) respectively).

To plot the slopes it is customary to evaluate the equation at the mean plus-and-minus one standard deviation of the level 1 predictor variable for groups defined at the mean plus-and-minus one standard deviation of the level 2 predictor variable. The mean and standard deviation of all variables can be read from the values given prior to establishing the equations in HLM. For the present example, the means and standard deviation of the two predictor variables are:

$$\begin{aligned} \text{fmot, mean} &= 0, \text{ s.d.} = 3.228 \\ \text{attclas, mean} &= 0, \text{ s.d.} = .753 \end{aligned}$$

Using these values, we can calculate the values for B0 and B1 using the two level 2 equations for both the low and high attclass values as follows:

$$\text{To compute B0:} \quad B0 = G00 + G01 (\text{ATTCLAS} - \text{mean}(\text{ATTCLAS}))$$

$$\text{Low attclas} \quad B0 = 55.413 + (-8.431)(-.753) = 61.76$$

$$\text{High attclas} \quad B0 = 55.413 + (-8.431)(.753) = 49.06$$

$$\text{To compute B1:} \quad B1 = G10 + G11(\text{ATTCLAS} - \text{mean}(\text{ATTCLAS}))$$

$$\text{Low attclas} \quad B1 = 2.906 + (-.067)(-.753) = 2.96$$

$$\text{High attclas} \quad B1 = 2.906 + (-.067)(.753) = 2.86$$

To compute the predicted values of the dependent variable, substitute these values into the following equation:

$$Y = B0 + B1(\text{fmot} - \text{mean}(\text{fmot}))$$

Thus, for:

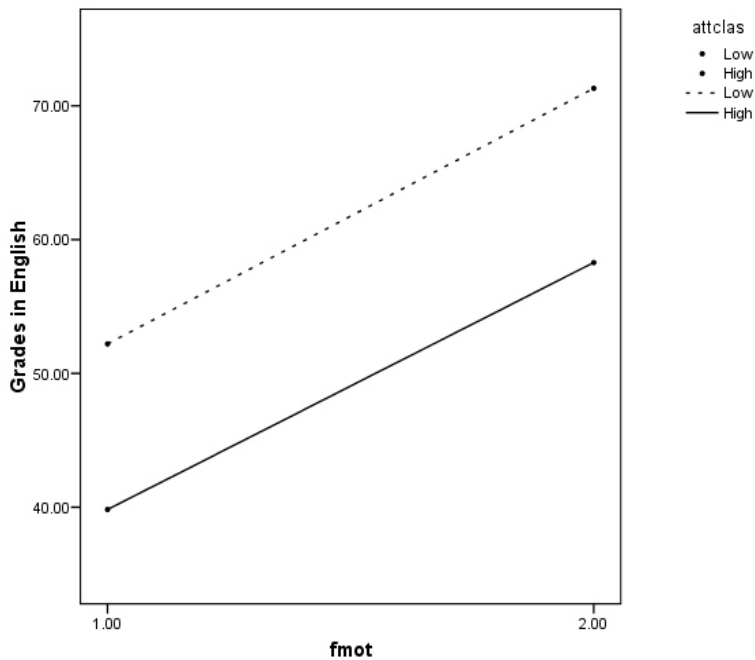
$$\text{Low attclas, low fmot} \quad Y = 61.76 + (2.96)(-3.228) = 52.21$$

$$\text{Low attclas, high fmot} \quad Y = 61.76 + (2.96)(3.228) = 71.31$$

$$\text{High attclas, low fmot} \quad Y = 49.06 + (2.86)(-3.228) = 39.83$$

$$\text{High attclas, high fmot} \quad Y = 49.06 + (2.86)(3.228) = 58.29$$

These values could then be plotted as follows:



As the graph shows, there is a positive association between grades in English and FMOT (as indicated by the significant value of G10) but no interaction between the slopes and ATTCLAS (as indicated by the non-significant value of G11). The difference of slightly more than 10% between the low and high levels of ATTCLAS reflects the near significance of G01. Note too that classes with the higher (more favourable) attitudes toward the learning situation tend to get lower grades (reflected in the negative sign of G01).