Plotting Within-Group Regression Lines: SPSS, R, and HLM
(For Hierarchically Structured Data)

Random Slope Model
To illustrate plots of random slopes, I used a different model from the HSB data, with SES as a predictor of math achievement. I present only the initial results from SPSS, because I have already illustrated a random slope model in the other packages.

get file='c:\jason\spsswin\mlrclass\hsbmerged.sav'.

* This analysis group-centered SES (necessary in this case--more later).
compute cses = ses - meanses.

MIXED mathach WITH ses
/CRITERIA=MXITER(1000) SCORING(1)
/METHOD = REML
/PRINT = SOLUTION TESTCOV HISTORY
/FIXED = ses | SSTYPE(3)
/RANDOM = INTERCEPT  ses | SUBJECT(schoolid) COVTYPE(UN).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Estimate</th>
<th>Std. Error</th>
<th>df</th>
<th>t</th>
<th>Sig.</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>12.665023</td>
<td>.189845</td>
<td>145.551</td>
<td>66.712</td>
<td>.000</td>
<td>12.289814, 13.040232</td>
</tr>
<tr>
<td>ses</td>
<td>.2393813</td>
<td>.118121</td>
<td>157.530</td>
<td>20.266</td>
<td>.000</td>
<td>2.160508, 2.627116</td>
</tr>
</tbody>
</table>

The results indicate a significant positive effect of SES. The variances of the slopes, given in the UN(2,2) row of the Estimates of Covariance Parameters box ($\tau^2 = .413$) was also significant after halving the p-value ($p = .079/2 = .0395$).
Graphing

SPSS

get file='c:\jason\spsswin\mlrclass\hsbmerged.sav'.

* The SELECT IF command below could be used to select the a subset of schools (commented).
* select if schoolid le 1637.
* The CASESTOVARS command aggregates the data to select a random subset of schools.
CASESTOVARS
  /ID=schoolid
  /DROP size to female.
* The sample command samples 15% of the groups from the total 160.
SAMPLE .15. /* You can also sample a certain number of cases, such as: SAMPLE 10 FROM 160.
* The VARSTOCASES command disaggregates the data again.
VARSTOCASES
  /MAKE ses from ses.1 TO ses.67
  /MAKE mathach from mathach.1 TO mathach.67.
* GGRAPH command is used to generate individual slopes for each group.
GGRAPH
  /GRAPHDATASET NAME="GraphDataset" VARIABLES= ses mathach schoolid
  /GRAPHSPEC SOURCE=INLINE.
BEGIN GPL
SOURCE: s=userSource( id( "GraphDataset" ) )
DATA: ses=col( source(s), name( "ses" ) )
DATA: mathach=col( source(s), name( "mathach" ) )
DATA: schoolid = col(source(s), name("schoolid"), unit.category())
ELEMENT: point(position(ses * mathach))
ELEMENT: line(position(smooth.linear(ses * mathach)), shape(schoolid))
END GPL.
**R**

In the below example, I use a new package `lme4` and R function `lmer` to make plotting easier.

```r
# install.packages(lme4)  # install packages if lme4 has not been used before
library(lme4)
model <- lmer(mathach ~ ses +(ses|schoolid), data=mydata)
summary(model)

# sample 15 schools
ids <- sample(unique(mydata$schoolid), 15)
mydata2 <- mydata[mydata$schoolid %in% ids, ]

# names fixed and random effects values from model and creates a combined data frame
fix <- fixef(model)
rand <- ranef(model)

# plot individual slopes for each school
plot(data = mydata2, mathach ~ ses, type = 'n',
     ylim = c(min(mydata2$mathach), max(mydata2$mathach)),
     xlim = c(min(mydata2$ses), max(mydata2$ses)),
     cex.main = .75,
     xlab = 'SES', ylab = 'Math Achievement ',
     main = 'Variability in Slope and Intercepts- School')
for(i in 1:length(unique(mydata2$schoolid))){
  abline(a = paramsStudent[i,1], b = paramsStudent[i,2], col = 'black')
  par <- par(new=F)
}

# add average slope (fixed effect)
abline(a = fix[1], b = fix[2], lwd= 5, col = 'black')
```

![Variability in Slope and Intercepts-School](image-url)
HLM

HLM graphs model results automatically. The built-in graphing functions are capable of a number of other kinds of graphs, but I demonstrate a basic one here (same general graph as obtained from SPSS)\(^1\).

File → Graph Equations → Level-1 equation graphing.

Under “X-focus”, choose the Level-1 predictor (here, it was SES). Under **Number of groups** choose whether you would to graph a random sample of groups, the first 10 groups, or all groups. If you choose a random sample (as I did here), input the probability (e.g., .15 for 15% of groups). Click **Ok**.

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\(^1\) Note that the R and HLM methods use a “model” graph which creates graphs based on the results of the model. So the lines are based on empirical Bayes estimates of the slopes rather than OLS. SPSS is producing OLS estimates which may appear to vary more across groups. The three graphs also differ because a different sample of groups was drawn in the three graphs.