Plotting Growth Curves

Below is an example of how to plot example growth curves in SPSS using the GGRAPH command.\(^1\) The CASESTOVARS is an alternative way to disaggregate the data set for growth curve analysis.

Basic Linear Growth Curves

```spss
COMPUTE W1=0.
COMPUTE W2=1.
COMPUTE W3=2.

SAMPLE 20 FROM 294.

VARSTOCASES
  /MAKE time "Wave Number" FROM w1 w2 w3
  /MAKE dep "Depression" FROM cesdtot1 cesdtot2 cesdtot3
  /KEEP=RID.

LIST VARS=rid time dep.

GGRAPH
  /GRAPHDATASET NAME="GraphDataset" VARIABLES= time dep rid
  /GRAPHSPEC SOURCE=INLINE.
BEGIN GPL
  SOURCE: s=userSource(id( "GraphDataset" ) )
  DATA: time=col(source(s), name( "time" ) )
  DATA: dep=col(source(s), name( "dep" ) )
  DATA: rid = col(source(s), name("rid"), unit.category())
  ELEMENT: point(position(time * dep))
  ELEMENT: line(position(smooth.linear(time * dep)), shape(rid))
END GPL.
```

Output

<table>
<thead>
<tr>
<th>RID</th>
<th>TIME</th>
<th>DEP</th>
</tr>
</thead>
<tbody>
<tr>
<td>139</td>
<td>.00</td>
<td>12.00</td>
</tr>
<tr>
<td>139</td>
<td>1.00</td>
<td>15.00</td>
</tr>
<tr>
<td>139</td>
<td>2.00</td>
<td>8.000</td>
</tr>
<tr>
<td>1241</td>
<td>.00</td>
<td>1.000</td>
</tr>
<tr>
<td>1241</td>
<td>1.00</td>
<td>6.072</td>
</tr>
<tr>
<td>1241</td>
<td>2.00</td>
<td>3.000</td>
</tr>
<tr>
<td>1273</td>
<td>.00</td>
<td>13.00</td>
</tr>
<tr>
<td>1273</td>
<td>1.00</td>
<td>12.00</td>
</tr>
<tr>
<td>1273</td>
<td>2.00</td>
<td>8.000</td>
</tr>
<tr>
<td>1380</td>
<td>.00</td>
<td>15.00</td>
</tr>
<tr>
<td>1380</td>
<td>1.00</td>
<td>12.00</td>
</tr>
<tr>
<td>1380</td>
<td>2.00</td>
<td>25.00</td>
</tr>
<tr>
<td>1958</td>
<td>.00</td>
<td>41.00</td>
</tr>
<tr>
<td>1958</td>
<td>1.00</td>
<td>33.00</td>
</tr>
<tr>
<td>1958</td>
<td>2.00</td>
<td>38.00</td>
</tr>
</tbody>
</table>

Number of cases read: 15   Number of cases listed: 15

\(^1\) SPSS has replaced the graphing command called IGRAPH in the most recent versions of SPSS (beginning with SPSS 19 or 20). These are the commands I used to use in case you are using an older version of SPSS:

```spss
IGRAPH
  /X1=var(time) TYPE=SCALE
  /Y=VAR(dep) TYPE=SCALE
  /STYLE=VAR(rid)
  /FITLINE METHOD=REGRESSION LINEAR LINE=TOTAL MEFFECT SPIKE=OFF
  /SCALERANGE=VAR(dep) MIN=0 MAX=30.
```

The graph will initially contain regression coefficient and $R^2$ labels for each line. To remove the regression equations follow these steps: (1) double click on the graph, (2) double click on the label, (3) choose options, then (4) uncheck the "show mean" and who "R-squared boxes".
Individual Observed Values By Case
The following syntax generates observed data points using a different version of the GGRAPH command, which is useful for examining each case more carefully. I selected only 6 cases at random for this example, and each is given a different color and line style.

SPSS Syntax

```
GGRAPH
   /GRAPHDATASET NAME="GraphDataset" VARIABLES= time dep rid
   /GRAPHSPEC SOURCE=INLINE.
BEGIN GPL
SOURCE: s=userSource( id( "GraphDataset" ) )
DATA: time=col( source(s), name( "time" ) )
DATA: dep=col( source(s), name( "dep" ) )
DATA: rid = col(source(s), name("rid"), unit.category())
GUIDE: axis(dim(1), ticks(null()))
GUIDE: axis(dim(2), ticks(null()))
ELEMENT: line( position(time*dep), shape(rid))
ELEMENT: point( position(time * dep),color(rid))
END GPL.
```

For individual observed points, the older method used the IGRAPH command based on examples by Singer & Willett (2003) to produce a series of separate dot plots for each case:

```
IGRAPH
   /X1=var(time) TYPE=SCALE
   /Y=var(support) TYPE=SCALE
   /STYLE=VAR(w1id)
   /FITLINE METHOD=REGRESSION LINEAR LINE=TOTAL MEFFECT SPIKE=OFF
   /SCALERANGE=VAR(support) MIN=0 MAX=4.
```
Nonlinear Curves

The following syntax explores curvilinear trajectories using the GGRAPH command.\(^3\) I selected only 6 cases at random for this example. Notice that the only differences in the GGRAPH command used for the linear plot is the last ELEMENT command which uses \textit{smooth.spline} instead of \textit{smooth.linear}.

\begin{verbatim}
GGRAPH
 /GRAPHDATASET NAME="GraphDataset" VARIABLES= time dep rid
 /GRAPHSPEC SOURCE=INLINE.
BEGIN GPL
 SOURCE: s=userSource(id( "GraphDataset" ))
 DATA: time=col(source(s), name( "time" ))
 DATA: dep=col(source(s), name( "dep" ))
 DATA: rid = col(source(s), name("rid"), unit.category())
 ELEMENT: point(position(time * dep))
 ELEMENT: line(position(smooth.spline(time * dep)), shape(rid))
END GPL.
\end{verbatim}

\(^3\) GGRAPH is replacing IGRAPH, which will soon be obsolete. The IGRAPH commands were as follows:

\begin{verbatim}
IGRAPH
 /X1=VAR(time) TYPE=SCALE
 /Y=VAR(dep) TYPE=SCALE
 /STYLE=VAR(rid)
 /SCALERANGE=VAR(dep) MIN=0 MAX=30
 /LINE(MODE) KEY-OFF STYLE-LINE INTERPOLATE=SPLINE.
\end{verbatim}
**Growth Curve Plots in R**

This plotting method gives OLS plots for a sample of cases

**Linear**

```r
rm(mydata2)
# sample 15 cases
ids <- sample(unique(mydata$rid), 15)
mydata2 <- mydata[mydata$rid %in% ids, ]

#View(mydata2)

## change rid to factor variable for plotting
mydata2 <- within(mydata2, {
  rid <- factor(rid)
})

library(lattice)
xyplot(depress~time, mydata2, group = rid,
type=c('p','r'), points = TRUE)
```

**Quadratic**

```r
rm(mydata2)
# sample 15 cases
ids <- sample(unique(mydata$rid), 15)
mydata2 <- mydata[mydata$rid %in% ids, ]

#View(mydata2)

## change rid to factor variable for plotting
mydata2 <- within(mydata2, {
  rid <- factor(rid)
})

# prints a loess curve, smoothed to span of 2, which may need be smaller or larger depending on the time values

xyplot(depress~time, mydata2, group = rid,
type='smooth',span=2)
```

Alternatively, model-based graphs (EB estimates instead of OLS) can be produced with the slightly more complicated code demonstrated in the handout "Plotting Within-Group Regression Lines: SPSS, R, HLM"
HLM software has a number of plots preprogrammed.

**Linear Growth Lines**  
Follow these menus: *File → Graph Equations → Level-1 equation graphing*. Then choose TIME as the X-focus and select the number cases to use (I chose a random selection of 15% in this example).

The slopes look more homogeneous because they are model-based lines (i.e., based on empirical Bayes estimates), so there is shrinkage compared to the OLS estimates generated in SPSS due to the low reliability of our slope estimates.

One can also choose to plot the average slope, by following *File → Graph Equations → Model graphs*, and then choosing TIME as the x-focus.

**Nonlinear Growth Lines**  
I generated the following graph of individual quadratic curves after testing the curvilinear model with CTIME and CTIMESQ in the model. Follow *File → Graph Equations → Level-1 equation graphing*. Then choose CTIME as the X-focus and select the number cases to use. Under *Categories/transforms/interactions*, click on a number button, and choose *power or x/z*. Then choose the quadratic variable, CTIMESQ, in the drop down menu on the left. The linear variable, CTIME, will appear in the center box automatically. Enter "2" in the last box on the right, because CTIMESQ is the square of CTIME (i.e., raised to the power of 2).