

## Model based graphs: Level-1 residual box-and-whisker plots

In addition to plotting predicted values for individual level-2 units using level-1 equations, users can also examine the distributions of the level-1 errors or residuals (see Equation 3.63 on p. 50 in *Hierarchical Linear Models*). The plots allow users to graphically examine the assumptions about the level-1 residuals and to identify cases for which the model provides a particularly poor fit. We continue to use **vocab.mdm** to illustrate this graphing procedure.

After the model is run, select **Graph Equations...Level-1 box whisker** from the **File** menu, which will give us the following dialog box.

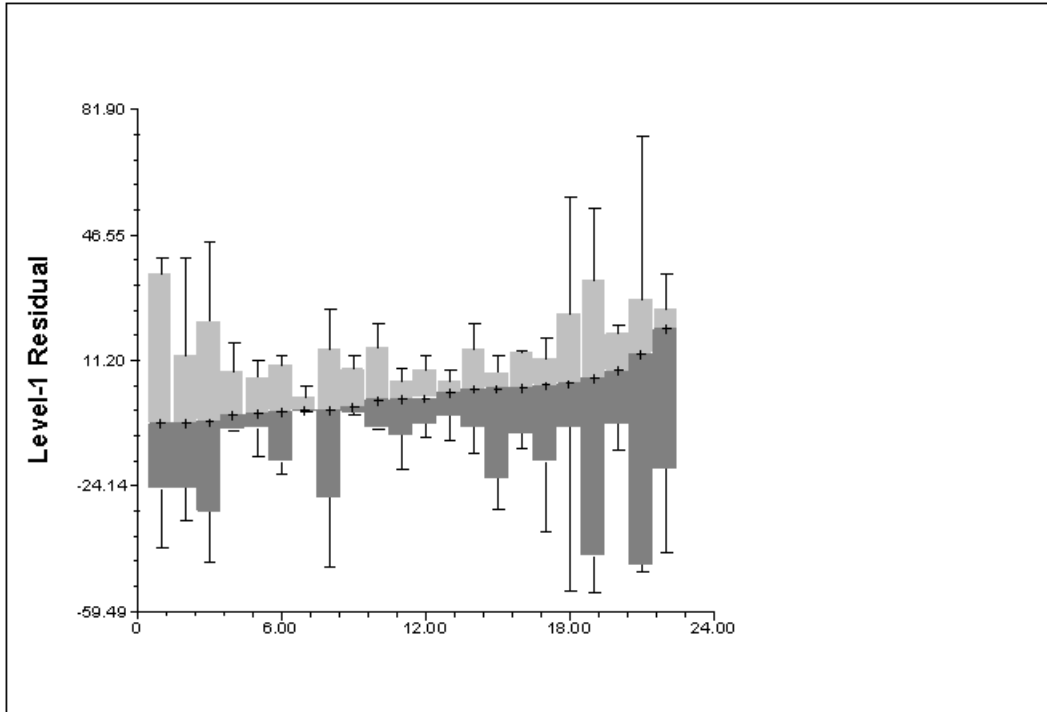
The dialog box titled "Choose Y for box plot" contains the following settings:

- Y-axis:** Level-1 residual
- Sort by:** original order (selected), median
- Z-focus:** (not chosen) (selected), 25th/50th/75th percentiles
- Number of groups:** First ten groups (selected)
- Probability (0 to 1):** [Empty text box]

Buttons: Cancel, OK

Note that the variable for Y-axis, level-1 residual has been pre-selected.

Select **All groups (n=22)** in the **Number of groups** field to include all the 22 children in the display. Click the selection button for **median** in the **Sort by** section to arrange the plots by median order. Click **OK**. The following graph will appear.



The box-and-whisker plots provide side-by-side graphical summaries of the level-1 residuals for each level-2 units. The plots suggests that the underlying model assumptions may not be tenable. First, quite a number of the distributions are highly asymmetric, such as the last one from the left. Thus, the normality assumption may not hold. There seems to be heterogeneity of variance as well, judging from the wide disparities in the box lengths. The non-constant residual spread may suggest an omission of important effects from the model. However, there are no extreme values or outliers in any of the 22 plots.

Users can (optionally) look at the EB estimates for any child by clicking on the corresponding box-and-whisker plot. A level-2 classification variable can also be included when examining the level-1 residuals.