



Model-based graphs – two level

WHLM provides graphing options to display the relationships between the outcome and the predictor(s) based on the final analytic results. The options allow us to visually represent the results of the models for the whole or a subset of population, and to graphically examine underlying model assumptions as well. Below we provide a 2-level example of a growth curve analysis of pro-deviant attitude for fourteen-year-old youth over a period of five years with data from the National Youth Survey (Elliot, Huizinga, & Menard, 1989; Raudenbush & Chan, 1993). In our example, the level-1 file, NYSW2.SAV, has 1,066 observations collected from interviewing annually fourteen-years-old youths beginning at 1976:

- ATTIT A nine-item scale assessing attitudes favorable to deviant behavior
Subjects were asked how wrong (very wrong, wrong, a little bit wrong, not wrong at all) they believe it is for someone their age, for example, to damage and destroy property, use marijuana, use alcohol, sell hard drugs, or steal.

The measure was positively skewed; so a logarithmic transformation was performed to reduce the skewness.
- AGE16 Age of participant at a specific time minus 16
- AGE16S = AGE16 * AGE16

The level-2 data file, NYSB2.SAV, consists of 241 youths and three variables per participant.

- FEMALE An indicator for gender (1 = female, 0 = male)
- MINORITY An indicator for ethnicity (1 = minority, 0 = other)
- INCOME Income

At level-1, we formulate a polynomial model of order 2 using AGE16 and AGE16S (see Figure 18.16) with FEMALE and MINORITY as covariates at level-2 modeling π_0 , the expected pro-deviant attitude score at age 16 for subject j ; π_1 and π_2 , which are the expected average linear and quadratic growth rate for pro-deviant attitude score respectively. The procedure for setting up the model is given in 2.5.2. We will ask WHLM to graph the predicted values of pro-deviant attitude scores at different ages for different gender-by-ethnicity groups.

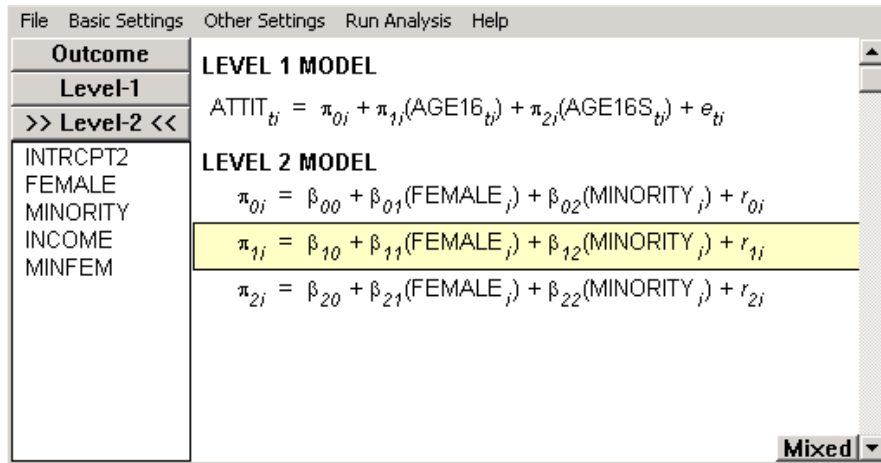


Figure 16 A polynomial model of order 2 with FEMALE and MINORITY as level-2 covariates

To prepare the graph

1. After running the model, select **Basic Settings** to open the **Basic Model Specifications – HLM2** dialog box.
2. Enter a name for the graphics file. The default name is **grapheq.geq**.
3. Enter a title and name the output filename, save the command file, and run the analysis as described in section 2.5.2.
4. Open the **File** menu and choose **Graph Equations**. An **Equation Graphing dialog** box will open (see Figure 17). Table 2 lists the definitions and options in the **Equation Graphing** dialog box.

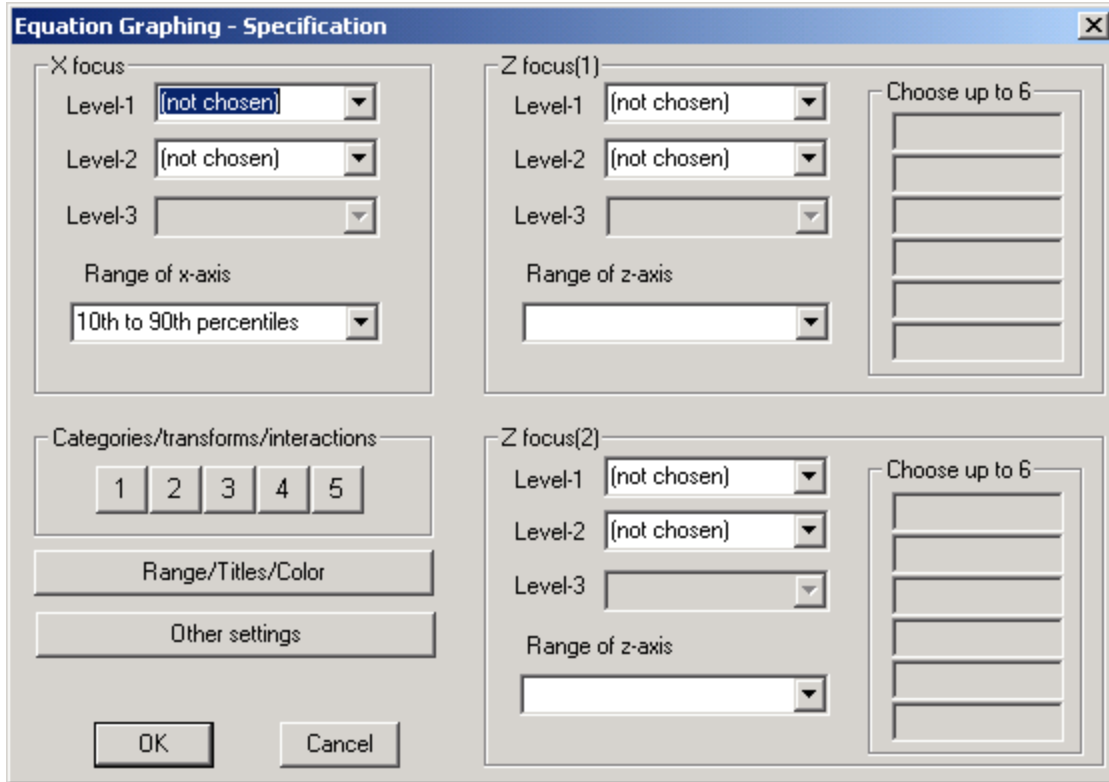


Figure 17 Equation Graphing – Specification dialog box

We now proceed to select the predictor variables and specify their ranges or values, and choose the graphing functions and the various attributes of the plot for the polynomial model represented in Figure 16, as described in Steps 5 to 14 below.

5. Select AGE16 in the **X focus Level 1** drop-down list box to graph pro-deviant attitude score as a function of age.
6. Select **Entire range** in the **Range of x-axis** drop-down list box to include the entire range of age on the x axis in the graph.

Table 2 Definitions and options in the Equation Graphing dialog box

| | Key terms | Function | Option | Definition |
|---|--|--|---|---|
| 1 | X focus | Specify the variable to be displayed on x-axis | 2 choices | 1. Level-1 predictor 2. Level-2 predictor |
| 2 | Range of x-axis | Specify the maximum and minimum values of X to be displayed | 5 choices | 1. 10 th to 90 th percentiles 2. 5 th to 95 th percentiles 3. 25 th to 75 th percentiles 4. +/- 2 s.e.'s 5. Entire range |
| 3 | Categories/ transforms/ interactions | Define the reference category for categorical variables with more than two levels, and specify the relationship between the transformed\interaction and the original variables | 5 choices | 1. define categorical variable (for variable with more than two levels) 2. interaction 3. power of x/z 4. square root 5. natural log |
| 4 | Range/ Titles/ Color | Specify the maximum and minimum values of X and Y to be displayed (defaults are values computed). Enter legend titles for X and Y. Enter graph title. Select screen color | 2 choices | 1. Black and white 2. Color |
| 5 | Other Settings | Specify graphing function Predictors not in graph Use fixed effects from These are only available for HGLM models, and Laplace is only available if Laplace was asked for in HGLM2/HGLM3 Bernoulli runs | 2 choices 2 choices 3 choices | 1. rough – original points 2. smooth – smoothed data 1. constant at grand mean (default) 2. constant at zero. 1. unit-specific PQL estimates 2. population-average estimates 3. unit-specific Laplace estimates |
| 6 | Z focus(1 or 2) | Specify the first or second classification variable for X | 3 choices | 1. Level-1 predictor 2. Level-2 predictor |
| 7 | Range of z-axis | Specify the specific values of Z focus to be included. | 4 choices for continuous variables 2 choices for categorical variables | 1. 25 th and 75 th percentiles 2. 25 th /50 th /75 th percentiles 3. Averaged lower/upper quartiles 4. Choose up to 6 values (enter the six values into the textboxes) 1. Use the two actual values 2. Choose one or two values |

- Click 1 in the **Categories/transforms/interactions** section and select **power of x/z** for Polynomial relationships. An **Equation Graphing - power** dialog box will open (see Figure 18).

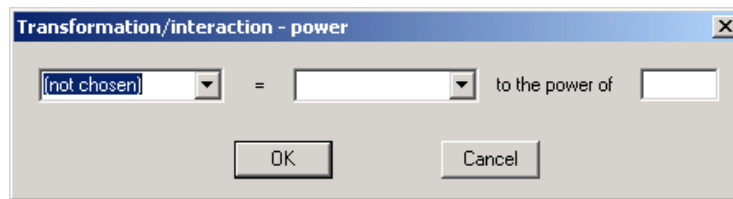


Figure 18 Equation Graphing – power dialog box

- The textbox to the left of the equal sign is for the entry of the transformed variable. Select AGE16S in the drop-down list box (see Figure 19). The textbox to the right is for the entry of the original variable. AGE16 will appear in the drop-down list box as it is the only level-1 variable left. Enter 2 in the textbox for the **power** to be raised. Click **OK**.

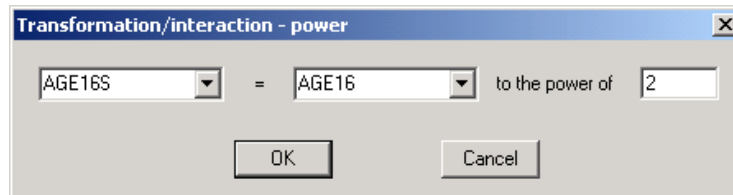


Figure 19 Equation for the transformed variable AGE16S

- Click **Range/Legend/Color** to specify the ranges for x- and y-axis (the default values are those computed from the data), to enter legend and graph titles, and to select screen color (see Figure 20). Enter **Pro-deviant attitude score as a function of age, gender and ethnicity** in the textbox for **Graph title**. Click **OK**.

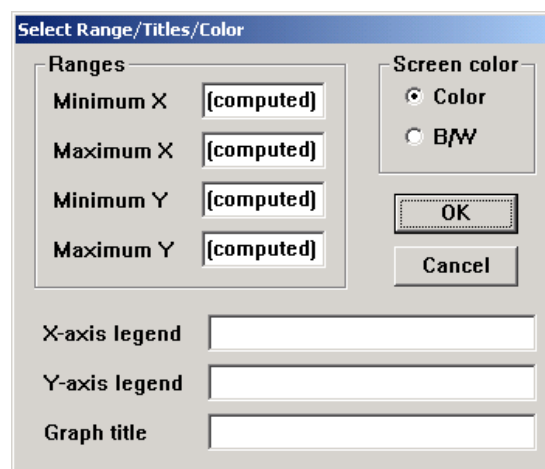


Figure 20 Select Range/Legend/Color dialog box

10. Click the **Other settings** button and click the selection button for **Smooth** in **For continuous x** section to display a set of smooth curves.
11. Select FEMALE in the **Z focus(1)** drop-down list box to graph pro-deviant attitude score as a function of age for male and female youths. **Use the two actual values** will appear in the textbox for the **Range of z-axis** as FEMALE is an indicator variable. We will use this default option.
12. Select MINORITY in the **Z focus(2)** drop-down list box to graph pro-deviant attitude score as a function of age for minority and non-minority male and female youths. **Use the two actual values** will appear in the textbox for the **Range of z-axis** as MINORITY again is an indicator variable. We will use this default option. See Figure 21 for the specifications for this growth curve analysis example.
13. Click **OK**. A colored version of the plot (not displayed here) showing the relationship between pro-deviant attitude score and age for different gender-by-ethnicity groups will appear (see Figure 22). The curves indicate that there is a non-monotonic and nonlinear relationship between pro-deviant attitude scores and age for minority and non-minority male youths over the five year period. Such a relationship, however, does not exist for minority and non-minority female youths.

The screenshot shows the 'Equation Graphing - Specification' dialog box with the following settings:

- X focus:**
 - Level-1: AGE16
 - Level-2: (not chosen)
 - Level-3: (not chosen)
 - Range of x-axis: 10th to 90th percentiles
- Z focus(1):**
 - Level-1: (not chosen)
 - Level-2: FEMALE
 - Level-3: (not chosen)
 - Range of z-axis: Use the two actual values
- Z focus(2):**
 - Level-1: (not chosen)
 - Level-2: MINORITY
 - Level-3: (not chosen)
 - Range of z-axis: Use the two actual values

Additional controls include 'Categories/transforms/interactions' (1, 2, 3, 4, 5), 'Range/Titles/Color', 'Other settings', 'OK', and 'Cancel' buttons.

Figure 21 Specifications for the Growth Curve Analysis Example

Pro-deviant attitude score as a function of age, gender and ethnicity

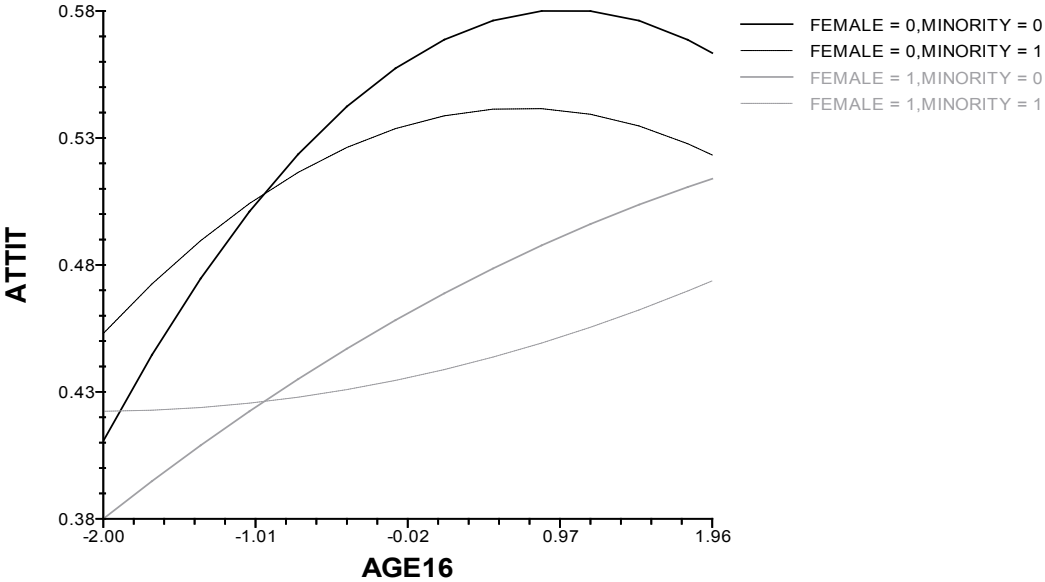


Figure 22 Plot showing the relationship between pro-deviant attitude score and age for different gender-by-ethnicity groups