The analysis is performed by clicking the **Run Analysis** option on the main menu bar after the model specification has been completed and/or the model has been saved.

The standard output file

By default, this file will be named **hlm2.txt**, **hlm3.txt**, **hmlm.txt**, **hmlm2.txt** or **hcm2.txt** and will contain the following:

> Ordinary least squares and generalized least squares results for the fixed coefficients defined in the level-2 model.
> Estimates of variance and covariance components and approximate chi-square tests for the variance components.
> A variety of auxiliary diagnostic statistics.
> Additional output for hypothesis-testing procedures and requested optional statistical features.
> Unit-specific and population-average results in the case of HGLM models.
> Output for a number of level-1 error structures, depending on model specification, for HMLM and HMLM2 models.

Residual files

Residual files are created during the analysis in the format specified during Step 2 above, and can be opened in the statistical package of choice for inspection and/or further analysis. Residual files are available for HLM2, HLM3, HGLM and HCM2 models but contents vary according to module.

The level-1 residual file will contain

> level-1 residuals (the differences between the observed and fitted values),
> the fitted values,
> the square root of sigma_squared,
> the values of the level-1 and level-2 predictors entered in the model, and those of other level-1 and level-2 variables selected by the user.
> A level-2 residual file will contain some or all of the following:
> EB residuals,
> OL residuals,
> and fitted values for each level-1 coefficient based on the estimated level-2 models posterior variances and covariances of the estimates of intercept and slopes
> level-2 predictors used in analysis plus additional level-2 predictors requested by the user for inclusion
> Mahanalobis distance of a unit's EB estimates from its fitted value
> Expected values of the order statistics for a sample of similar size from a population with chi-square(v) distribution
> Three estimates of the level-1 variability: the natural log of the total standard deviation within each unit, the natural log of the residual standard deviation within each unit based on its least squares regression, and the natural log of the residual standard deviation from the final fitted fixed effects model.

A three-level analysis will produce two residual files, one at level-2 and one at level-3. The 3-level residual file contains the EB residuals, the OL residuals, fitted values, posterior variance

and covariances; listed by level-3 unit ID.

In the case of HGLM analyses using HLM2 or HLM3, residual file contents are based on the unit-specific model results.

In addition, level-2 predictors can be included in the level-2 residual file and level-3 predictors in the level-3 residual file. However, other statistics provided in the residual file of HLM2, for example the Mahalanobis distance measures, are not available in the residual files produced by HLM3.

The row residual file (produced only by HCM2) contains the following the Empirical Bayes estimates and its associated posterior variances, and additional predictors as selected by the user for inclusion in the residual file.

The column residual file (produced only by HCM2) contains the Empirical Bayes estimates and its associated posterior variances, and additional predictors as selected by the user for inclusion in the residual file

Variance-covariance matrices of estimates:

In addition, HLM offers output files containing the variance-covariance matrices of estimates of fixed effects and variance-covariance parameters. These can be saved by checking the print variance-covariance matrices option (available for HLM2, HLM3 and HGLM models only) in the **Output Settings** dialog box accessed via the **Other Settings** menu. These files can be opened in Notepad, Wordpad etc. In the case of HGLM analyses using HLM2 or HLM3, contents are based on the unit-specific model results.

Model-based graphs:

Finally, HLM offers the option to make model-based graphs after completion of the analysis. HLM2 and HLM3 offers the complete range of graphs, while HMLM, HMLM2 and HCM2 offer a subset of options. Options available on this dialog box for the various modules are listed in the overview of modeling options in HLM modules. Examples can be viewed by looking at the model based graphs page.