

***Mixed Models with Heterogeneous Variance:  
Applications in Smoking Research***

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Mixed models are increasingly used for analysis of longitudinal data. In these models, random subject effects are included to account for the correlation of the clustered observations within subjects. Typically, interest centers around describing and statistically comparing time-trends across groups of subjects. These comparisons focus on statistical tests of the fixed effects of the model. The error variance and the variance parameters of the random effects are usually considered to be homogeneous across subject groups. These variance terms characterize the within-subjects (i.e., error variance) and between-subjects (i.e., random-effects variance) variation in the longitudinal data. In this presentation, we will describe examples of mixed models that allow these variance terms to vary across groups of subjects, and illustrate that such models have useful applications in psychological and social sciences research. For example, in smoking research a common theme is that physical and emotional reactions to smoking stabilize as one's experience with smoking increases. Indeed, one aspect of the concept of dependence is that responses to smoking become more internally stable or driven, and less dependent on external or situational contexts. To examine this issue, we will present analyses of data from a longitudinal adolescent smoking study. This study contains multi-layered longitudinal data in that subjects are measured across three measurement waves, and at each wave data from seven days are collected from each subject using hand-held palm pilots. This type of design allows us to address several issues in terms of the stability of variance parameters, both at a given wave as well as across time. For a given measurement wave, we will examine how the variances in these reactions to smoking vary across groups of subjects characterized by their smoking history. We will also explore this issue longitudinally, across waves, to examine the degree to which the variances change as adolescents progress in their smoking career. For continuous response data, standard software (e.g., SAS PROC MIXED) can be used to fit these models. Some syntax examples are provided in the appendix of this article to facilitate use of these models.