

## **Formulating mixed models for experiments, including longitudinal experiments**

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Mixed models have become important in analyzing the results of experiments particularly those that require more complicated models such as those that involve longitudinal data. In this presentation a method for deriving the terms in a mixed model is described. It extends the method described by Brien and Bailey [*J. Roy. Stat. Soc., Series B*, 68 (2006): 571–609] to explicitly identify terms for which autocorrelation and smooth trend arising from longitudinal observations needs to be incorporated in the model. At the same time we retain the principle that the model used should include, at least, all the terms that are justified by the randomization. This is done by dividing the factors into sets, called tiers, based on the randomization and determining the crossing and nesting relationships between factors.

An alternative to the "Split-Plot-in-Time" analysis of variance and mixed model for the randomized complete block design with longitudinal observations is outlined. The mixed model analysis of data from a three-phase experiment to investigate the effect of time of refinement on Eucalyptus pulp from four different sources is also described. For this example, cubic smoothing splines are used to describe differences in the trend over time and unstructured covariance matrices between times are found to be necessary.