Web-based Supplementary Materials for

"An Application of a Mixed-Effects Location Scale Model for Analysis of Ecological Momentary Assessment (EMA) Data"

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Below is a sample of syntax necessary to run the mixed location scale model described in this article. In this syntax, uppercase letters are used for SAS specific syntax and lowercase letters are used for user defined entities. In terms of the variables used in this syntax, `y` denotes the outcome, `x1` denotes a prompt- or time-varying covariate, `x2` denotes a subject-level or time-invariant covariate, and `id` is a subject identifier. The random location effect is named `u1` and the random scale effect is named `u2`. The model for the mean response is summarized by `z`, with the regression coefficients ($\boldsymbol{\beta}$) named `b0`, `b1`, and `b2`. The model for the BS variance is given by `varu1`, with `lnvaru1` indicating the reference BS variance (*i.e.*, the between-subjects variance when the covariate `x2` equals 0), in ln units, and `alp1` characterizing how this variance varies with `x2`. Similarly, for the model of the within-subjects (WS) variance, `vare` is modeled in terms of a reference variance `lnvare`, in ln units, with coefficients `tau1` and `tau2` specified for the two WS variance influences `x1` and `x2`, respectively.

```
PROC NLMIXED GCONV=1e-12;
PARMS b0=.25 b1=-.5 b2=.3 lnvaru1=1 varu2=.05 cov12=0
       alp1=0 lnvare=1 tau1=0 tau2=0;
z = b0 + b1*x1 + b2*x2 + u1;
varu1 = EXP(lnvaru1 + x2*alp1);
vare = EXP(lnvare + x1*tau1 + x2*tau2 + u2);
MODEL y ~ NORMAL(z,vare);
RANDOM u1 u2 ~ NORMAL([0,0], [varu1,cov12,varu2]) SUBJECT=id;
RUN;
```

Users must provide starting values for all parameters on the `PARMS` statement. To do so, it is beneficial to run the model in stages using estimates from a prior stage as starting values and setting the additional parameters to zero or some small value. For example, one can start by estimating a random-intercepts model with fixed effects ($\boldsymbol{\beta}$), BS variance (`lnvaru1`), and WS variance (`lnvare`). Estimates of these parameters can then be specified as starting values in a model that adds in the WS variance parameters $\boldsymbol{\tau}$, and then the BS variance parameters $\boldsymbol{\alpha}$ (or vice versa). Finally, the full model with the additional parameters σ_{ω}^2 (or `varu2`) and $\sigma_{\upsilon\omega}$ (or `cov12`) can be estimated. In practice, this approach works well with PROC NLMIXED, which sometimes has difficulties in converging to a solution for complex models. Also, in our experience, it seems that specifying a small starting value for the second random effect variance (σ_{ω}^2 or `varu2`) helps model convergence. Furthermore, for complex models, it is sometimes the case that the default convergence criteria is not strict enough. In the above syntax, the convergence criteria is specified as `GCONV=1e-12` on the `PROC NLMIXED` statement. The results in this article did change a bit as this stricter criteria was applied, relative to the default specification, however the results did not change beyond this level. It would seem that this level is a reasonable choice, however it probably should be examined on a case-by-case basis.