Abstract
Understanding temporal change in human behavior and psychological processes is a central issue in the behavioral sciences. Intensive longitudinal data (ILD), which contain many observations across time are increasingly generated by studies of human behavior. ILD allow description of detailed behavioral patterns as well as a consideration of related environmental and psychosocial antecedents and consequences. To explore the relationship between time-varying covariates and outcomes of interest, traditional analytic approaches pose constraints in terms of parametric assumptions about temporal changes in these relationships. We introduce a time-varying effect model (TVEM), which poses no functional form constraints on the shape of behavioral trajectories and allows model parameters to vary over time, providing a useful and flexible framework for ILD analysis. We describe the types of research questions TVEM addresses, outline the model estimation procedure, apply the model to ILD collected as part of a smoking cessation study, and demonstrate model utility with a simulated example.

Time-varying Effect Model (TVEM)

Traditional linear regression models are:

\[ Y_t = \beta_0 + \beta_1 x_{t-1} + \beta_2 x_{t-2} + ... + \beta_k x_{t-k} + \epsilon_t \] (1)

Such models assume constant relationship between behavior outcome and relevant covariates. That is, the association between outcome y and the first covariate x1 is always B1 over the study period.

TVEM extended traditional linear regression models:
1) Allow temporal change in intercept and associations
2) Shapes of temporal changes are not specified a priori

While Equation (1) tries to force the data into a pre-specified shape, TVEM (Equation (2)) tries to find a shape that follows the change in the data.

\[ y_{it} = \beta_0(t) + \beta_1(t) x_{it} + \beta_2(t) x_{it}^2 + ... + \beta_p(t) x_{it}^p + \epsilon_{it} \] (2)

TVEM is a useful model for ILD in studying complicated temporal change in behavior resulting in
1) Non-normally distributed data;
2) Inter-individual variability;
3) More specific error structures;
4) ...