Bayesian Piecewise Linear Mixed Models with a Random Change Point

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Abstract: To study the pathogenesis of autoimmune (Type 1) diabetes (T1D), proposed accelerator and overload hypotheses postulate that overweight and rapid growth speed up both beta cell insufficiency and an increased insulin resistance. A child's growth (weight) trajectory during childhood starts with a phase of fast growth and then a phase of slow growth. An individual's growth pattern is important because it might be associated with the risk for either 1) islet autoimmunity, 2) clinical onset of T1D, or both. Here, we introduce a Bayesian two-phase piecewise linear mixed model, where the "change point" is an individual-level random effect corresponding to the timing connecting the two growth phases. This method is used to estimate the weight trajectories for children from the Environmental Determinants of Diabetes in the Young (TEDDY) study and then assess the association between the random effects (pre-change slope, post-change slope, change point) and the risk of either 1) islet autoimmunity or 2) clinical onset. The pre-change slope (i.e., the growth rate in the phase of fast growth) was significantly associated with the risk of islet autoimmunity.