Case Study 1-Group 1

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Introduction

- Data: A study by Longnecker et al. (2001), comprised of 2380 observations of pregnant women.
- Goal: Assess how DDE and PCBs relate to risk of premature delivery.

Data Preprocessing

- Preterm birth: Gestational Age ≤ 36.
- Standardize continuous variables.
- Missing data: Multivariate Imputations by Chained Equations (MICE package in R).
- Limit of Detection (LOD): Exists in some PCBs. All LODs are negligible compared to data scale (e.g. 0.01 compared to 0.3)

Collinearity & Dimensionality Reduction

- There are 11 types of PCBs, some of which have high correlation and may be redundant.
- Possible approaches: Simple sum, PCA, Factor Analysis .
- Alternative approach: model with regularization (e.g. LASSO).
- Check Multicollinearity: Variation Inflation Factor (VIF).

Model

- Generalized Additive Model (GAM)

$$g(Y_i) = \beta_0 + \sum_{j=1}^{m} f_i(x_{ij}) + \sum_{k=1}^{l} \beta_k z_{ik}$$

- Choice of g: probit or logit.
- $x_{.j}$s include DDE, PCBs.
- $z_{.k}$s include categorical variables and confounding variables.

Model

- Frequentist model overestimates uncertainty.
- Bayesian Generalized Additive Model

$$g(Y_i) = \beta_0 + \sum_{j=1}^{m} f_i(x_{ij}) + \sum_{k=1}^{l} \beta_k z_{ik}$$

- Adds priors on the common regression coefficients, priors on the standard deviations of the smooth terms.

Discussion

- Mixed Effect / Random Effect
- Generalized Additive Mixed Model (GAMM)
- Bayesian GAMM

Discussion

- Monotone effect: Bayesian Isotonic Regression (Neelon, B. and Dunson, D.B. 2004)
- Including Interactions: Bayesian Factor Analysis (Ferrari, F. and Dunson, D.B. 2019)