

Question 1 (30%)

Return to the Trolley data, `data(Trolley)`. Define and fit a varying intercepts model for these data. Cluster intercepts on individual participants, as indicated by the unique values in the `id` variable. Include action, intention, and contact as ordinary terms.

- (a) Construct a varying intercepts model and a model that ignores individuals.
- (b) Compare the two models using both WAIC and posterior predictions. What is the impact of individual variation in these data?

Question 2 (45%)

Varying effects models are useful for modeling time series, as well as spatial clustering. In a time series, the observations cluster by entities that have continuity through time, such as individuals. Since observations within individuals are likely highly correlated, the multilevel structure can help a lot. You'll use the data in `data(Oxboys)`, which is 234 height measurements on 26 boys from an Oxford Boys Club, at 9 different ages (centered and standardized) per boy. You'll be interested in predicting height, using age, clustered by Subject (individual boy).

- (a) Fit a CENTERED model with varying intercepts and slopes (on age), clustered by Subject using STAN.
- (b) Fit a NON-CENTERED model with varying intercepts and slopes (on age), clustered by Subject using STAN.
- (c) Present and interpret the parameter estimates from one of the above model. Which varying effect contributes more variation to the heights, the intercept or the slope?

Question 3 (45%)

Let's revisit the Bangladesh fertility data, from assign 5 Q3.

- (a) Fit a CENTERED model with both varying intercepts by `district_id` and varying slopes of urban by `district_id` using STAN. (y: `use.contraception`)
- (b) Fit a NON-CENTERED model with both varying intercepts by `district_id` and varying slopes of urban by `district_id` using STAN. (y: `use.contraception`)
- (c) Inspect the correlation between the intercepts and slopes from one of the above model:
 - (1) Plot the mean (or median) varying effect estimates for both the intercepts and slopes, by district.
 - (2) Plot predicted proportion of women using contraception, with urban women on one axis and rural on the other, might also help.