**Example Application VII (Mixed effects survival model)**

You are interested in the effect of pollution on the survival rate of larvae of a given species. To explore this, you conduct an experiment. The experiment involves collecting 20 batches of larvae (each from a different parent) and creating 40 experimental units (randomly) from each batch (i.e. 800 units in total). The first 20 units for each batch are a control and the second 20 are the treatment units. There are 1,000 larvae in each unit, and the experiment involves counting the number of larvae alive after 30 days. The data in each unit are assumed to be binomially distributed with a probability of survival given by:

 (1)

where μ determines the population level survival rate (control conditions);  is the effect of batch *b*, ;  is the effect of unit *u*, , and  is factor for the treatment.

**Tasks**

1. Fit model 1 with and with random effects and record the estimates of  and their standard errors (hint use “map” to control which parameters are to be estimated).
2. Compute Pearson residuals, i.e.

 (2)

and plot these as histograms. Then explore patterns in these residuals to see if there is visual evidence to support the random effects structure.