Problem 1: EDA plots

The two new EDA plots suggest that the most reasonable mixed model structures for these data seem to be GLMMs with random intercepts, with or without random slopes across the trials.

Problem 2: Results

The mean absolute anticipatory timing (AAT) for male and for female is 0.1225 (SD = 0.1733) second and 0.1389 (SD = 0.1127) second respectively, which indicates that on average females are farther off in timing than males. In general, visitors improve across trials. AAT within the five trials are mean[trial 1]=0.1450, SD=0.1299; mean[trial 2] = 0.1386, SD=0.2121; mean[trial 3] =0.1162, SD=0.1225; mean[trial 4] = 0.1279 SD=0.1443; mean[trial 5] = 0.1162, SD=0.1409. Likelihood ratio test, AIC and BIC are used to select random-effects based covariance structures in general linear mixed models. A final model with the first-order main effects of sex, trial and age, as well as quadratic term of age and random gender-specific intercept is therefore used. The variance of the random intercept for male is estimated to be 0.0148, and the variance of the random intercept for female is 0.0037, while the variance of the random error is 0.0097. There are significant effects of age (F = 19.40, P = <.0001) and its quadratic term (F = 14.41, P = 0.0002) on AAT, which with first order term coefficient estimate -0.0159 and quadratic term coefficient estimate 0.0003. It implies that AAT first decreased as age increases, but after around age of 30, AAT increased as age increases, averaging across gender and trial. In addition, this study showed a non-significant linear improvement of anticipatory timing ability across the five trials (F = 5.42, P = 0.0203), with the slope estimator of -0.00683. Finally, model diagnostics did not find any obvious violations of model assumptions.

Problem 3: Comparison of final models by GLM and GLMM

Although both final models include the same set of fixed effects, i.e., sex, trial, age and quadratic term of age, the final model by GLMM provides a better fit to the data. More specifically, the final model from GLMM has AIC = -763.6 and BIC = -755.5, compared to AIC = -632.4 and BIC = -480.6 for the final model from GLM.