Result and Analysis: Question 5

The data was collected from 10 participants across 200 trials each. For each participant, it was first divided into the 0.1, 0.3, 0.5, 0.7, 0.9 quantiles and fit across two models; the drift diffusion model using the Wald distribution and the Ex-Gaussian distribution. The DDM used two free parameters; boundary separation and drift rate whereas the starting point was kept constant. The ex-gauss fits varied across all its three parameters; the mean, standard deviation and the decay rate.

The data was fit for each participant using Simplex to generate g-squared values with parameters being generated using Maximum Likelihood Estimation. The g-squared error values indicate how well is the data fit to a particular distribution – higher the g-squared error, worse the fit.

The g-squared errors were then "punished" proportional to the number of free parameters for each model; error was increased more for a model with more free parameters as follows:

*New_gsq = Old_gsq + 2 * free_parameters*

In order to compare the goodness of fit for each participant, the new g-squared error across models was then squished using a softmax selection function giving out the probability of the data being generated by one of the models.

Softmax function $\sigma(\mathbf{z})_j$

$$\sigma(\mathbf{z})_j = \frac{e^{z_j}}{\sum_{k=1}^{K} e^{z_k}} \quad \text{for } j = 1, \cdots, K.$$

Where *z* is the new g-squared value and k = 2 for two models

These probabilities were then squished within the range [0.15, 0.85] to show restraint in over-confidence on one model generating the data using the following equation.

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f(x) = (b-a)(x – min)/(max – min) + a
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Where a and b are 0.15 and 0.85 respectively. Min and max are 0 and 1, indicating the minimum and maximum values probabilities can take.

A General Consensus:

The model preference for both models across 10 participants, on average, do not significantly differ. (Mean probability for wald = 0.528; mean probability for Ex-Gaussian = 0.472). Since we are accounting for number of free parameters in each model and because these probabilities have been scaled; the difference of means is likely squished. If one model has to be picked, the Wald distribution seems more likely considering the factors above.

Research and Analysis: Q6

The data was collected from 20 participants in a correlated scores design across two conditions: taking Ritalin or Placebo. A Drift Diffusion Model using the Wald distribution was used to explain the data. In one case, the data was fit with an assumption that Ritalin had a significant impact on the Response Time distributions. The Ritalin effect was quantified using the drift rate parameter of the DDM. Thus, under the assumption of significant Ritalin effect, the drift rate varied across two conditions; which was thus treated as an additional free parameter in fits. For the alternate hypothesis of Ritalin having no effect, the drift rate was thus kept the same across two conditions.

Fit procedure followed the same protocol as for the previous case; returning g-squared values comparing how well the data fit with Wald models with multiple drift rates (for an effect condition) and single drift rate (for no effect condition). The data was fit across 100 trials for each participant (50 in each condition).

The g-squared value was then punished proportional to the number of free parameter values each model has. Thus, it increased more for the model with the free drift rate than for the model with same drift rate across conditions.

The new g-squared was again squished into a softmax to give out probabilities for each model and scaled to account for over-confidence.

A General Consensus

There was a larger difference in mean probabilities of selecting each model (0.454 for the model with fixed drift rate and 0.546 with the model with free drift rate) implying it was more often likely that the data came from the model with varying drift rate.