Topic 7 problems: Model fitting

1. Wichmann and Hill (2001) show that it is important to include a *lapse rate* parameter when fitting a psychometric function. This is a parameter that gives the psychometric function a minimum other than zero, and a maximum other than one. This models the fact that on some trials an observer's attention wanders, and the observer simply guesses the correct response.

   For example, if we add a lapse rate parameter λ to the cumulative normal psychometric function that we used in the lecture code, we get:

   $$\psi(x; \mu, \sigma, \lambda) = \lambda + (1 - 2\lambda)\Phi(x; \mu, \sigma)$$

   This function has a minimum value λ and a maximum value $1 - \lambda$.

   Write an R script that fits this function to the made-up data we used in the lecture code.

2. Suppose you fit a cumulative normal psychometric function without a lapse rate parameter to data that actually has a lapse rate $\lambda > 0$. Will you be able to detect this mistake by checking the deviance of the fit? To investigate, write an R script that implements the following steps.

   (a) Generate made-up data from a psychometric function that has a reasonably large lapse rate, e.g., $\lambda = 0.05$.

   (b) Fit a cumulative normal psychometric function without a lapse rate parameter to this data. Find the deviance.

   (c) Using the same kind of simulation we used in the lecture code, find the deviance distribution of data generated from the fit in part (b).

   (d) Is the deviance you found in part (b) implausibly far out in the tail of the distribution you generated in part (c)?