3. Bayes – Exercise 3

This exercise is about applying a Bayesian approach to signal detection theory. The question poses a situation in which an observer with d' = 1.5 does signal detection in three different conditions with each condition having a different probability for trials containing a signal. The probabilities are listed as such:

- Condition 1: 50%
- Condition 2: 95%
- Condition 3: 15%

Equal variance SDT is assumed, so d' can be interpreted as the sensitivity of the observer, and it is assumed that the observer applies the maximum a posteriori decision rule.

The 2nd lecture slides states an equation for the relation between the signal probability, d' and the criterion c in the case of the max a posteriori rule:

$$P(signal) = \frac{1 - \exp\left(-\frac{(c-d')^2}{2}\right)^{\frac{1}{\sqrt{2\pi}}} - \left(-\frac{c^2}{2}\right)^{\frac{1}{\sqrt{2\pi}}}}{\exp\left(-\frac{(c-d')^2}{2}\right)^{\frac{1}{\sqrt{2\pi}}} - \left(-\frac{c^2}{2}\right)^{\frac{1}{\sqrt{2\pi}}}}$$

As stated, d' and the signal probability in each condition is already given, so to get the criterion c in each condition, we simply plug in the signal probability and d' and then isolate. This has been done using the solve-function with the online tool WolframAlpha, yielding the following results:

- Condition 1 (50%): -1,29
- Condition 2 (95%): -1,38
- Condition 3 (15%): -0,96

It makes sense that a higher signal probability yields a lower criterion value (more left-ward criterion), as this would cause the observer to say yes more often (that he observed a signal).