Mind, Brain, and Models 2020/21

CNCR

Comparison stimuli Observer Standard stimulus

In this lab, you will implement two models of an optimal observer in a psychophysical experiment. The experiment: At each trial, a standard stimulus and a comparison stimulus are presented. The comparison stimulus is chosen at random among 7 preselected values (1:7). The standard has a value of 4. The optimal observer has a representation of the two sensed values, and its algorithm is that his response should be 0 or 1.

Part of the goal of the lab and the assignment are to learn good Matlab code practice, including tools like blocks, using meaningful variable names according to style reference, and commenting (look at http://www.datatool.com/prod02.htm). This is a possible header template for a script with which to start

```
%$NAME - One line description of what the script performs (H1 line)
%   Optional file header info (to give more details about the function than in the H1 line)
%   Optional file header info (to give more details about the function than in the H1 line)
%   Optional file header info (to give more details about the function than in the H1 line)
%
%   Description:
%       $NAME description
%
%   Output:
%       $NAME output
%
%   Other m-files required: none
%   MAT-files required: none
%
%   See also: OTHER_SCRIPT_NAME,  OTHER_FUNCTION_NAME

%   Author:
%   email:
%   Date: $date;
%
%   Last revision: $date, Author, Changes
```

1) The first step of the assignment is a trial-by-trial simulation of the algorithm of the optimal observer. The experiment comprises 5000 trials (`nTrials`). At each trial, select one comparison at random. Be sure to read the manual entry for `randn` (or `seed` depending on the Matlab version). Try to use a randomization without replacement rather than a randomization with replacement if you can (and comment which one you choose). The value of the comparison stimulus used and of the response should be stored individually for each trial.
2) The data should be analyzed by calculating the mean of the responses for each value of the comparison stimulus.
3) Now you will add noise to the sensory process of the optimal observer (effectively limiting the precision of the estimate). On the code you wrote before, add a random value to each of the two stimuli (standard and comparison) in each trial. The random value should come from a Gaussian distribution with a standard deviation of 1.5 and a mean of 0.
4) Plot the mean response as a function of the value of the comparison (psychometric function). The shape of this function should be a cumulative Gaussian. Label the axes (`xlabel,ylabel`) and select the appropriate scale (`axis`), try to stylize the line with a color and change the `xticks` to match the set of stimuli presented.
5) We will perform what is called a PROBIT analysis which is a way to determine the parameters of the psychometric function. It is a way of fitting the data, thus it is based on a model of the process. This model normalizes the proportion of responses (y axis in your graph) and fits them with a line to find the empirical values of mean and standard deviation of the Gaussian function on which the psychometric function is based.
First, create a new mean response limited variable limiting values of the psychometric functions between 1/5000 and 1-1/5000 so to exclude 0 and 1 values (the next step can't deal with them). Then transform the values in PROBIT units using the `norminv` function (the range of values should be roughly between -3.7 and 3.7 rather than for 0 to 1). Fit a line on the values using the function `regress`. The input parameters of this functions should be as follows: the x value should have two columns, the left made of ones, the right made of the comparison stimulus values; the y value should have the transformed responses. The function will return one output argument (here we will call it *a*, but give it a better name). The response criterion of the optimal observer is *-a(1)/a(2)* and the variance is *1/a(2)*. Plot a cumulative Gaussian using (almost) these two values to check that if matches the response data. Clean up your code, comment it and send it in.