Problem set 2

The R script `model.R` defines a function `bob()` that is a model observer for a 2AFC depth discrimination task with stimuli defined by binocular disparity and touch. The first line of the function's definition is

```
bob <- function( depthD1=NaN, depthT1=NaN, depthD2=NaN, depthT2=NaN )
```

To simulate showing depth stimuli to `bob()`, you pass input arguments that have the depths you want to show. `depthD1` is the depth from disparity in the first stimulus interval, and `depthT1` is the depth from touch in the first stimulus interval. `depthD2` and `depthT2` are the corresponding depths for the second interval. Depths are measured in cm. If one of these input arguments is set to `NaN` (which is the default value), then `bob()` ignores that cue.

When you call `bob()` this way, it returns a value of 1 or 2, to indicate which stimulus it sees as having greater depth. As with human observers, there is a random component in `bob()`'s decision rule, so if you call `bob()` with the same input arguments twice, you do not necessarily get the same answer twice.

For example, to get `bob()`'s response to a stereo depth of 10 cm in the first stimulus interval and 11 cm in the second stimulus interval, you could call

```
response <- bob( depthD1=10, depthD2=11 )
```

`bob()` will return `response=1` if the first stimulus seems deeper, and `response=2` if the second seems deeper. To show a a cue conflict stimulus in the first interval and a consistent stimulus in the second interval, you could call

```
response <- bob( depthD1=10, depthT1=11, depthD2=12, depthT2=12 )
```

1. Is `bob()` better at depth discrimination using stereo or touch? Measure `bob()`'s d' for discriminating between depths of 10 cm and 12 cm over 200 trials, using only stereo cues. Then measure d' for discriminating between the same two depths using only touch cues.

2. Does `bob()` combine stereo and touch cues optimally? Measure a point of subjective equality (PSE) function where `bob()` judges whether stimuli at a range of depths have more or less depth than a 10 cm reference stimulus. Do this for stereo stimuli, touch stimuli, and combined stereo-and-touch stimuli. Fit normal cdf's to these three PSE functions and use the slopes (i.e., the σ parameters) of the fitted functions to test for maximum likelihood cue combination.

3. Optional bonus question. Do another test of whether `bob()` combines cues optimally. Measure another PSE function to find the depth that `bob()` perceives in a cue conflict stimulus where the stereo cue indicates a depth of 10 cm and the touch cue indicates a depth

of 14 cm. Compare this perceived depth to what you would expect if `bob()` combines cues optimally, given the σ's you measured in question 2.

In a real experiment to answer the questions posed here (e.g., is d' higher for stereo or touch?), you would of course use statistical tests. You don't need to use statistical tests for this problem set. I've written `bob()` so that the answers are clear enough without statistics.

Due date: April 9