PSYC 4165: Homework 1 Assignment (SDT EPT)

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Homework Assignment 1 - 10 Points

Due by 23:30, Friday, 26 January 2018

There are two parts to this homework assignment. Each part counts 5 points. Late homework will receive a grade of zero. Your homework must be prepared using R markdown language. You can use the Home1_SDT_EPT_Help_P4165_2018_Spring.Rmd file as a guide, changing the date and the author name of course and adding your own commentary. Knit your Rmd markdown file to a pdf file and upload the pdf file to the course Dropbox in Canvas by the the deadline indicated above. Work on the homework over the weekend and seek help from us via email or office hours next week. Do not wait until the last minute. You will learn a a lot doing this homework.

Part 1: Sensitivity and Bias

In 1977 the pharmaceutical company Warner-Lambert introduced the first in-home pregnancy test: Early Pregnancy Test or E.P.T. In the published clinical trials they reported the data given below. Of the 487 pregnant women tested, the E.P.T. indicated that 451 were pregnant and indicated that 36 were not pregnant. Of the 198 non-pregnant women tested, the E.P.T. indicated that 15 were pregnant and that 183 were not pregnant.

Table 1: Number of 'no' and 'yes' responses for pregnant and not-pregnant woment in the 1977 clinical trials of the Warner-Lambert Early Pregnancy Test.

	'No'	'Yes'
Not Pregnant	183	15
Pregnant	36	451

Consider that the signal (s1) is pregnancy and the blank (s0) is non-pregnancy. Use the equal-variance signal detection theory model to determine the sensitivity (d-prime) and response bias (c) of the E.P.T test. Use Equations 9c and 12 in the Signal Detection Handout. Present your work in an orderly fashion by showing the transformations of the above response frequencies into the probabilities of the four possible outcomes (i.e., HR, MR, CRR, and FAR). Then transform these probabilities into z-scores (quantiles of the unit standard normal distribution). In R, the function `qnorm()` may be used to compute quantiles (z-scores) from probabilities. Compute the overall accuracy of the test (A_z) using Equation 14 (`da` equals d-prime in the equal variance model). Given the accuracy and bias of this test do you think it is a good test? Why?

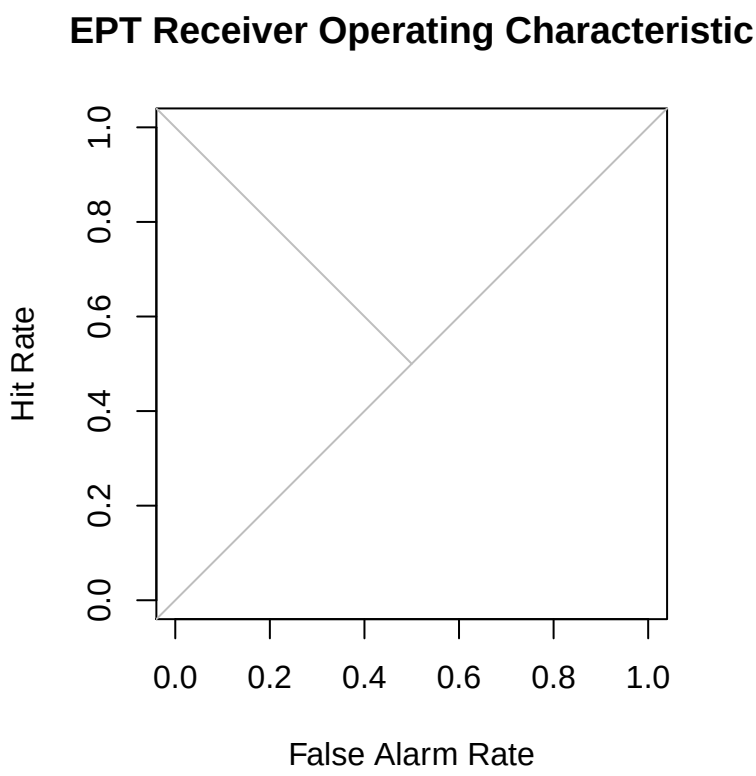

Figure 1: Receiver operating characteristic of the Warner-Lambert E.P.T. home pregnancy test. The filled circle is the resulting hit rate and false alarm rate computed from the clinical trials data. The smooth curve represents the predictions of the equal-variance signal detection model. The gray positive diagonal represents the hit rates and false alarm rates that would occur if the test had no ability to predict pregnancy. The gray negative diagonal represents the hit rates and false alarm rates that could occur with an unbiased test.

Part 2

Construct an ROC graph with FAR on the horizontal axis (the abscissa) and HR on the vertical axis (the ordinate). Set the axes to cover the range from 0 to 1 (plot command arguements `xlim = c(0, 1)` and `ylim = c(0, 1)`). Make the plot square by calling the parameter function: `par(pty = "s")` before you call the plot command. Plot the HR and the FAR of the E.P.T. on the graph. Draw a smooth ROC curve through the HR,FAR pair (see the help file for details how to do this if you need to). Be sure to label the axes.

It should look like Figure 1, with of course, your results added. The gray positive diagonal represents the hit rates and false alarm rates that would occur if the test had no ability to predict pregnancy. The gray negative diagonal represents the hit rates and false alarm rates that could occur with an unbiased test. The figure legend is created by the fig.cap= arguement in the code chunk header (e.g., `{r fig.cap="some text string."}`).