ECE511/PSY511 PSYCHOPHYSICS

A Joint Offering by the School of Electrical and Computer Engineering

And the Department of Psychological Sciences

Purdue University

Fall 2005

HW #2 (Assigned: 09/13/05; Due: *before lecture* on 09/20/05)

Topic: A Decision Model for Psychophysics

(Hit and False-alarm Rates, Sensitivity Index d′, Bias c)

(1) Derive the relationships d′=z(H)–z(F) and c= –0.5[z(H)+z(F)]. You will need to use the assumption of Gaussian probability density functions with equal variance for $p(x|S_1)$ and $p(x|S_2)$. Also recall that the z-scores are defined by:

$$H = \int_{-\infty}^{z(H)} \frac{1}{\sqrt{2\pi}} e^{-\frac{x^2}{2}} dx \qquad F = \int_{-\infty}^{z(F)} \frac{1}{\sqrt{2\pi}} e^{-\frac{x^2}{2}} dx$$

[Hint: Try to express z(H) and z(F) in terms of M_1, M_2, k and σ first.]

(2) Suppose d′=1. What is H if F = 0.01, 0.02, 0.10, 0.25 and 0.50? Same for d′=0.5, 2.0 and 3.0. Present your results in a table like shown below. Please briefly explain the key steps in your calculations.

F \ d′	0.5	1.0	2.0	3.0
0.01				
0.02				
0.10				
0.25				
0.50				

(3) For the following data matrices shown in lecture, find d′ and c. Compare and discuss the results.

(a)

	R_1	R_2
S_1	48/50	2/50
S_2	1/50	49/50

(b)

	R_1	R_2
S_1	5/50	45/50
S_2	1/50	49/50

(c)

	R_1	R_2
S_1	2/50	48/50
S_2	49/50	1/50

(4) Suppose $(H_{old}, F_{old}) = (0.6, 0.2)$. If $d'_{new}=2d'_{old}$, find (H_{new}, F_{new}) if

a. $c_{new}=c_{old}$

b. $c'_{new}=c'_{old}$

c. $\ln(\beta)_{new}=\ln(\beta)_{old}$

[Hint: Refer to Macmillan & Creelman's book for definitions of c' and $\ln(\beta)$.]

(5) What is the percent-correct score for a 1-I experiment when $d'=1.0$? You may assume that bias $c = 0$ in your derivation. If you have made any *additional* assumptions, please state them explicitly and clearly.