

**Homework 1: Signal Detection Theory**  
**20 Points: Due at the beginning of class, Tuesday, 14 September 2004**

There are two parts to this homework assignment. Each part counts 10 points. Late homework will receive a grade of zero.

**Part 1:**

In June of this year the FBI began administering polygraph tests to civilian officials in the Pentagon in an effort to learn who could have revealed certain highly classified intelligence information to former Iraqi exile Ahmad Chalabi. Mr. Chalabi has been accused of giving this secret information to the Iranian government. Below are data from two professional polygraph operators who were tested on their ability to detect liars. They tested 100 people: 50 of them lied about committing a crime and 50 told the truth. The resulting 2 x 2 contingency tables for each operator are presented below:

		Operator A				Operator B	
		“Liar”	“No”			“Liar”	“No”
Telling Lies		20	30	Telling Lies		40	10
Telling Truth		10	40	Telling Truth		30	20

Using the **equal-variance** signal detection theory model determine the sensitivity for detecting liars (“d-prime”) and the response bias (“c”) of each polygraph operator. Present your calculations in an orderly fashion. If you were guilty of giving Mr. Chalabi the classified intelligence information, and you did not want to be caught, which polygraph operator would you want to examine you. Why?

**Part 2:**

Below is a set of **hit rates** and **false alarm rates** computed from the confidence judgments of a one subject in a signal detection experiment.

	1	2	3	4	5
Hit Rate	0.2898	0.5477	0.7169	0.8275	0.9229
False Alarm Rate	0.0135	0.0829	0.2386	0.4146	0.7056

Plot two ROC graphs from these data: one graph in linear probability coordinates (ranging between 0.0 and 1.0), the other in Gaussian z-score coordinates (ranging from -2.5 to +2.5). Make the x- and y-axes of your graph equal in length so that each graph forms a square. Take care to properly label your graphs and to make them neat. What is your opinion about how well the Gaussian signal detection model describes these data? In four sentences or less explain your answer.