

## Homework 1: Signal Detection Theory

### 20 Points: Due at the beginning of class, Tuesday, 6 September 2005

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

#### Part 1:

Valerie Plame Wilson is a United States Central Intelligence Agency officer, who was identified as a CIA operative in a newspaper column by Robert Novak on July 14, 2003. The ensuing political controversy, commonly referred to as the Plame affair, or the CIA leak scandal, has led, in late 2004, to a Justice Department investigation into possible violation of criminal statutes, including the Intelligence Identities Protection Act of 1982. 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” using Equation 9c) and the response bias (“c” using Equation 12) of each polygraph operator. Present your calculations in an orderly fashion. If you were guilty of leaking Ms. Wilson’s identity to the press, 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.