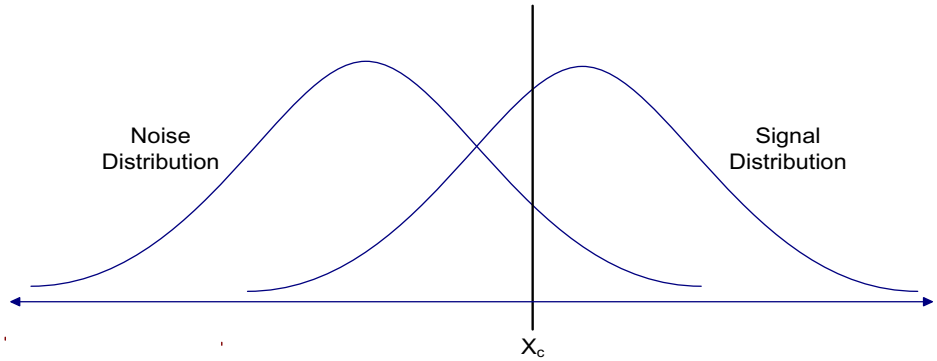
ECE511/PSY511 PSYCHOPHYSICS
A Joint Offering by the School of Electrical and Computer Engineering
And the Department of Psychological Sciences
Purdue University
Fall 2018

HW #5 (Assigned: 09/20/2018; Due: *before lecture* on 09/27/2018)

Topic: Signal Detection Theory, Rating Experiments

(1) Given the figure below:

a. Shade and label the following areas: hit rate (H), false alarm rate (FA), correct rejection rate (CR), miss rate (M), response rate of "Yes, the signal was present", and response rate of "No, the signal was not present". Note that X_c is the response criterion.



b. Discuss whether the participant has a liberal (tend to produce false alarms) or conservative (tend to miss the signals) response behavior based on the plot shown above. Is there anyway to modify this behavior?

c. Let Pc be the probability of a correct response. Determine an expression for Pc in terms of the *a priori* stimulus presentation probabilities P(S1) & P(S2), hit rate (H), and false alarm rate (F).

(2) List possible experimental situations or areas of interests which may reasonably be studied using rating methods with the following response sets:

a. A set of 10 numbers

b. Binary responses plus three categories of certainty

c. Verbal categories instead of numerical ones to signify degrees of certainty

(3) The following data were collected from three airport baggage examiners whose job is to decide whether to pull a bag for manual examination based on X-ray images. In this context, pulling a bag that contains suspicious objects is considered a hit. In the first experiment, the examiners were asked to be liberal in order to avoid misses. In the second experiment, they were asked to remain neutral (i.e., unbiased). In the last experiment, they were asked to be conservative in order to minimize false alarms.

Participant	Criterion	H rate	FA rate
1	Liberal	0.85	0.65
	Unbiased	0.65	0.30
	Conservative	0.50	0.25
2	Liberal	0.9	0.45
	Unbiased	0.55	0.15
	Conservative	0.25	0.05
3	Liberal	0.80	0.75
	Unbiased	0.65	0.50
	Conservative	0.35	0.20

a. Plot the ROC curve in terms of z(H) and z(F) for each participant and put all the curves on the same graph.

b. Based on the data, did all three participants adopt criteria that were consistent with the instructions? Discuss.

c. Which participant has the highest sensitivity? Justify.