

Bayesian Data Analysis
A PHY 451/551 and I CSI 451/551
UNDERGRADUATE PROJECT ASSIGNMENTS

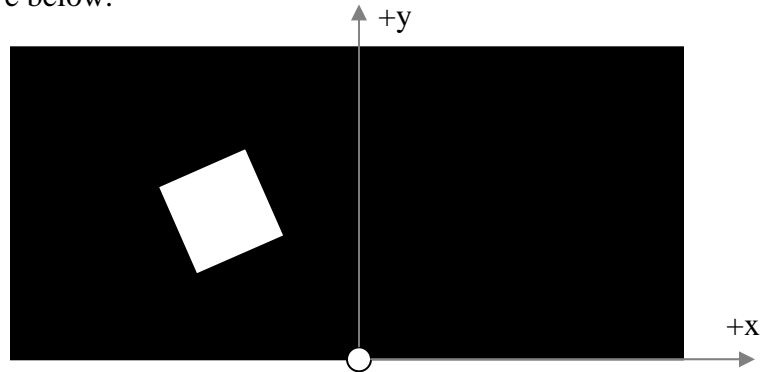
Undergraduates choosing not to undertake a final project must complete one of these two final Project Assignments

OPTION I: Characterizing a Geometric Shape

There is a Black Playing Field on which lies a White Square.

A robot has collected a set of light intensity measurements at a variety of points in the playing field. Given the set of measurement coordinates, and the measured intensities report the estimates center coordinates, side length and orientation of the square along with the associated uncertainties in your estimates. Along with these values, include a figure showing the estimated position and orientation of the square on the playing field. This figure should be generated by your Matlab software.

An example is give below.



Additional information:

The light sensor reports a mean value of 60 ± 5 when measuring the intensity of a white area, and 25 ± 5 when measuring from a dark area. The Playing Field extends from -50 to 50 in the x-direction, and from 0 to 50 in the y-direction. The square's center is certainly on the playing field, but part of the square may extend outside the playing field. The square is believed to have a side length of 15 ± 5 units. The square's orientation is not known.

DATA VALUES:

X	Y	Intensity	X	Y	Intensity	X	Y	Intensity
-2	52	25	-22	40	59	-14	45	57
-1	51	25	-19	38	56	-11	56	24
0	52	28	-17	38	54	-6	47	43
-34	42	30	-6	33	21	5	39	21
-3	42	23	-16	31	24	-3	50	47
-16	36	53	-19	47	63	-22	28	23
-17	34	26	-17	45	56	30	30	22
2	49	26	1	37	21			

OPTION II: Coins in a Bag



A clear ziplock bag contains many coins of various denominations, which include four types: pennies, nickels, dimes, and quarters. Given the weight of the bag determine the probability distribution of the numbers of coins of each denomination.

1. What is your estimate of the number of coins of each denomination (include mean and standard deviation)?
2. What is your estimate of the total amount of money in the bag (include mean and standard deviation)?

Hint: You will need to weight a bunch of pennies, nickels, dimes, and quarters on your own to get a prior estimate of not only their mean weight but also the variance! **NOTE: The mass of the penny changed in 1982 as we moved from copper pennies to copper-plated zinc pennies. You will have to take this into account and estimate the number of pennies of each type. All coins are post 1965, and none are silver.** You can then marginalize over both penny types to get a posterior probability for pennies alone.

PRIZE: After you have derived the probabilities and solved the problem, you may then decide on a guess for the number of coins of each denomination. Guesses not based on proper estimates will not be counted. The team (or teams) with results closest to the correct answer will split the bag of coins.