CoSMo Exercises Weds02

1. You are engaged in a reaching task where you try to hit targets on a computer screen with your fingertip. Your motor error for the reaching task is isotropic (round) bivariate Gaussian with a standard deviation in the vertical direction of 4 mm and the same in the vertical. You are presented with a target and penalty area that are two rectangles, each 2 mm (horizontal) by 8 mm (vertical) that are side by side. You can aim anywhere on the screen and your motor error distribution is always centered on your aim point. If you hit the green region then you get $10 but if you hit the red region you lose $10. If you miss both regions, you get $0. Where should you aim?

Please solve this problem two different ways.

1A. **Monte Carlo**. For a grid of aim points that cover the target/penalty area (maybe 10 x 10) and simulate 10000 movements for each aim point and calculate your winnings or losses. Form a contour plot of the average winnings for each aim point in the grid. Find the aim point with the maximum expected value.

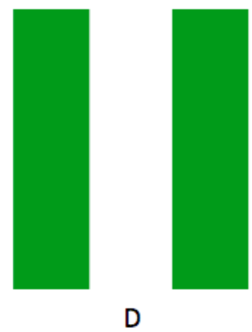
Plot the surface plot with the aim point that maximizes expected value marked. Extra: do this again with a finer grid.

1B. **Calculus**. Because the regions are rectangular, you can solve this by using the cdf of the Gaussian. Do so and make a contour plot as in 1A with the aim point that maximizes expected value marked.

1C. Repeat 1A or 1B (your choice) but with the red penalty set to $50. Compare the aim point that maximizes in 1A/1B and in 1C. Did it move when you changed the penalty?

1D. Repeat 1C but with your motor error set to 6 mm (you drank too much coffee). What happens to the optimal aim point?

2. You are engaged in a reaching task where you try to hit targets on a computer screen with your fingertip. Your motor error for the reaching task is isotropic (round) bivariate Gaussian with a standard deviation in the vertical direction of 4 mm and the same in the vertical. You are presented with a target area consisting of two rectangles, each 2 mm (horizontal) by 8 mm (vertical) that are separated by a distance D. You can aim anywhere on the screen and your motor error distribution is always centered on your aim point. If you hit either of the green region then you get $10, otherwise $0. You can assume that the aim point that maximizes expected gain is on the horizontal line going through the center of the rectangle.



2A. When D is 0, where is the aim point maximizing the expected value?

2B. When D is very large, where should you aim? Is the aim point maximizing the expected value unique?

2C. Plot the off set from the center of the configuration formed by the two rectangles of the aim point maximizing expected value as a function of D. If there are more than one aim point aim point maximizing expected value plot both.

2D. Speculate. If we did this experiment interleaving many targets with different D's ranging from 0 to very large what do you think people would do?