

Homework #2

Due date: 2/19/2013 (Tuesday)

1. What is BOLD? In your own words, fully explain the mechanism of BOLD fMRI (from stimulus input to image voxel signal). (20 points)
2. What common imaging sequences are used in BOLD fMRI? Why do we normally use gradient-echo EPI instead of spin-echo EPI for BOLD fMRI? (5 points)
3. Describe some common image artifacts found in fMRI EPI studies. (5 points)
4. In your own words, what is linear system? What is impulse response? (10 points)
5. Explain event-related design. In traditional event-related design, we need to separate each event with a reasonable time, please explain why we don't have to obey this rule in rapid event-related design. (10 points)
6. What is the mathematical relationship between block and event-related designs? (5 points)
7. In your own words, please explain the equation " $Z = X\beta + \varepsilon$ " that has been used in fMRI design and data analysis. (10 points)
8. In your own words, what is block-related design? How is the general equation " $Z = X\beta + \varepsilon$ " modified in block-related design? (5 points)
9. Please compare the advantages and disadvantages of block and event-related designs. (5 points)
10. How is % BOLD signal change calculated in block-related design? (5 points)
11. During the lecture on Jan 13 and Feb 5, we walked through the matrix operation of " $Z = X\beta + \varepsilon$ " with two examples. But we did not have enough time to fill up the matrices for all time points in the class. In this homework, you need to complete these two examples. Plot the outputs and explain what the outputs mean. (20 points)