STAT 113: COMPARING MORE THAN TWO MEANS

Brain size typically shrinks as people age past adulthood, and such shrinkage may be linked to dementia. Therefore, any intervention that can protect against brain shrinkage could help to protect the elderly against dementia and Alzheimer's disease. Researchers in China recently investigated whether different kinds of exercise/activity might help to prevent brain shrinkage or perhaps even lead to an increase in brain size (Mortimer et al., 2012).

The researchers randomly assigned elderly adult volunteers into four activity groups: tai chi, walking, social interaction, and no intervention. Except for the group with no intervention, each group met for about an hour three times a week for 40 weeks to participate in their assigned activity. The tai chi group was led by a tai chi master and an assistant, the walking group walked around a track, the social interaction group met at a community center and discussed topics that interested them, and the no intervention group just received four phone calls during the study period. A total of 120 participants started the study, and 13 dropped out along the way, so 107 completed the study.

Each participant had an MRI to determine brain size before the study began and again at its end. The quantitative outcome of interest was *percentage increase or decrease in brain size from baseline* during that time. They thought that physical activity would help increase brain size, hence they anticipated that the tai chi and walking groups would tend to show larger increases in brain size during the study than the other activity groups.

(1) Identify the cases, and the explanatory and response variables. For each variable, identify whether it is quantiative or categorical.

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(2) What parameters would make the most sense to focus on?

(3) Is this an experimental or observational study? How do you know?

(4) We can state the null and alternative hypotheses in terms of whether or not the explanatory and response variables are associated. What would it mean in the context of the research question if there is an association?

(5) The brain size increases/decreases by group are shown in the box plots below. What is your visual impression of the effect of the various exercise regimes on change in brain size?
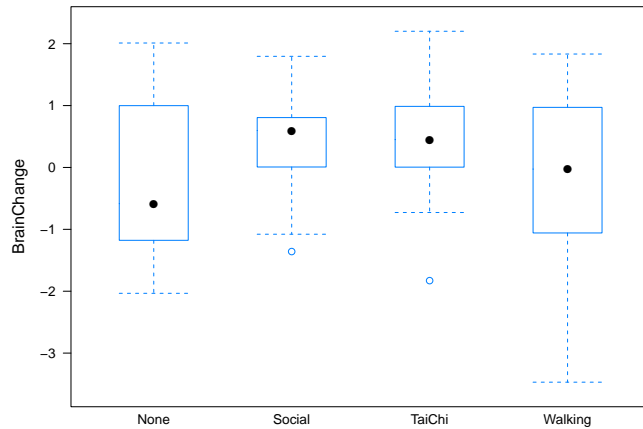

FIGURE 1. Brain size change from beginning to end of the study

(6) Propose a method for creating one randomization sample of size $n = 107$ from a world in which the null hypothesis being true.

(7) Propose a test statistic that measures the extent to which the group means are different from each other. Again, there are many reasonable choices; the

key is that the statistic must be a single number that tells us how "far away" the sample values are from our expectations under H_0.

(8) What values of your statistic represent samples that are "far" from the null? Large values? Small values? Large or small values on either extreme?

(9) Describe how you would use your randomization procedure together with your test statistic to carry out the test and compute a P-value.

(10) If the P-value is small, what will your conclusion be in context?

(11) How does the fact that 13 people started but didn't finish the study affect your interpretation of the results, if at all?