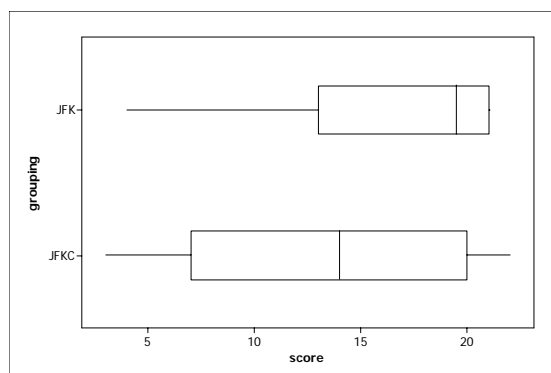
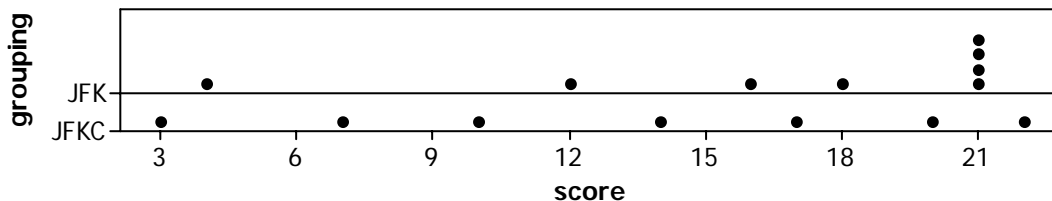


Stat 150 – Day 20 Statistical Significance

Recall that last week you memorized as many letters as you could in 20 seconds, from a sequence of 30 letters. Unbeknownst to you at the time, two different groupings of letters were used, and you were randomly assigned to one group or the other. Our research question was: Do the recognizable three-letter groupings improve memory scores, as compared to the less recognizable groupings? The experimental results are displayed in the graphs below and summarized in the statistics below:



Variable	grouping	N	Mean	StDev	Minimum	Q1	Median	Q3	Maximum
score	JFK	8	16.75	6.09	4.00	13.00	19.50	21.00	21.00
	JFKC	7	13.29	6.97	3.00	7.00	14.00	20.00	22.00

a) Does this descriptive analysis provide evidence in support of the research hypothesis that recognizable three-letter groupings improve memory scores? Explain.

b) Is it *possible* that the grouping of letters has absolutely no effect, and the difference observed here in our experiment is merely the result of random assignment?

The issue of **statistical significance** asks whether the observed experimental results would be surprising to occur if there were really no effect/difference between the groups. In this case, we explore whether the observed difference between the groups is statistically significant by investigating how often a difference this large would occur by chance (random assignment) alone, if there really were no effect/difference between the groups

We investigate this issue by assuming that all 15 subjects would have obtained the same memory score regardless of which group they had been in, and we repeat the random assignment process over and over. For each time that we repeat the random assignment process, we calculate the difference in mean (or median) scores between the two groups.

c) Take 15 index cards, one to represent each subject in the study. Write down the 15 memory scores, one score per card. Then shuffle up the cards and randomly deal out 8 for the JFK group and 7 for the JFKC group. Calculate the mean score for each group, and then calculate the difference in means, being careful to take the JFK group mean minus the JFKC group mean. Report the two group means as well as the difference.

JFK mean: JFKC mean: Difference in means (JFK – JFKC):

d) Repeat c) again.

JFK mean: JFKC mean: Difference in means (JFK – JFKC):

e) Put two dots, one for each of your “difference in mean” values from c) and d), to a dotplot on the board. Suggest a good label for the axis of that dotplot.

f) What proportion of the “difference in mean” values generated by the class are at least as extreme as the actual difference in means from our memory experiment?

g) Does it appear that the actual result would be surprising to occur by chance alone if there really were no effect/difference between the groups? Explain.

The proportion in f) is called an approximate **p-value**. If a p-value is very small, that indicates that the observed data between the groups differ enough to be considered statistically significant, meaning that the observed difference is unlikely to occur by chance alone if there were no effect/difference between the groups. This in turn would provide strong evidence that there truly is an effect/difference between the groups. A p-value of .05 or less is generally considered to provide fairly strong evidence of a difference/effect, while a p-value of .01 or less is generally considered to provide very strong evidence of a difference/effect.

We can approximate the p-value more accurately by performing many more repetitions of the random assignment process. For this we turn to a java applet, available from our course web page by following the link in the announcements box. Alternatively, you can go to: <http://www.rossmanchance.com/applets/>, and click on “Randomization test for quantitative response” in the bottom left.

h) Go to this applet, and click on “split format.” Enter the data as they appear below, with the name “JFK” at the top of the first column and “JFKC” at the top of the second column.

JFK	JFKC
4	3
12	7
16	10
18	14
21	17
21	20
21	22
21	*

Be sure to put an asterisk (*) in the last row of the second column. After you have entered the data, click on OK (you may need to scroll down to see the OK button). Then click on “Re-Randomize,” and the applet will do a new random assignment, just like you did above. Report the difference in means for this new random assignment.

i) Click on “Re-Randomize” four more times. Then un-check the “Animate” button, and enter 995 for the number of repetitions. Click on “Re-Randomize.” Describe the distribution of the 1000 differences in group means. (Comment on the shape, center, and spread of the distribution.)

j) Determine the approximate p-value from these 1000 repetitions by entering the observed difference in group means in the “Count samples beyond” box, and then click on the “Go” button. Report the value that you enter in that box and also report the approximate p-value.

k) Is this approximate p-value small enough to provide fairly strong, or very strong, evidence that the JFK group really does memorize more letters, on average, than the JFKC group? Explain the reasoning process behind your answer..

l) Did this study involve random sampling, random assignment, both, or neither?

m) Describe the implications of your answer to l) on the scope of conclusions you can draw from this study.