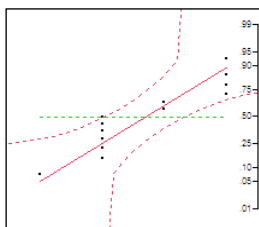# STAT 110: Practice Problem 19 Solutions

Fall 2017

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1. Researchers at the University of South Alabama compared the attitudes of male college students toward their fathers with their attitudes toward their mothers. Each of a sample of 13 males was asked to complete the following statement about each of their parents: My relationship with my father (mother) can best be described as (1) Awful, (2) Poor, (3) Average, (4) Good, or (5) Great. The data (shown below) can be found in the file Parents_Attitudes.JMP.

	Student	Attitude toward Father	Attitude toward Mother	Difference
1	1	2	3	-1
2	2	5	5	0
3	3	4	3	1
4	4	4	5	-1
5	5	3	4	-1
6	6	5	4	1
7	7	4	5	-1
8	8	2	4	-2
9	9	4	5	-1
10	10	5	4	1
11	11	4	5	-1
12	13	5	4	1
13	13	3	3	0

Research Question: Do male college students tend to have on average more favorable attitudes towards their mothers than fathers?

   a. Explain why these samples are <u>dependent</u>.
      The observations in the two groups (Attitude toward mother vs. Attitude toward father) are paired according to student.

   b. The research question is shown above. Carry out the formal hypothesis test to answer this question. Be sure to also check assumptions!

      Based on the normal quantile plot (shown below), the differences may not be from a normal distribution. However, since there is only a slight departure from normality, we will go ahead and use the t-test. We could also ask JMP to carry out the nonparametric Wilcoxon test (which does not assume normality).
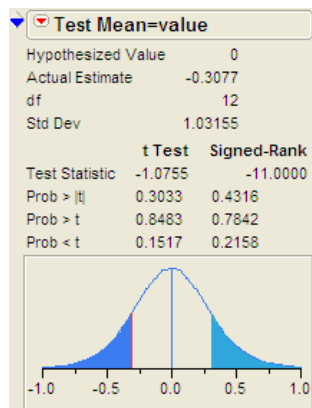

   H_o: $\mu_{father-mother} = 0$ (males have equally favorable attitudes toward their mother or father)
   H_a: $\mu_{father-mother} < 0$ (males have more favorable attitudes toward their mother than father)

The study does not provide enough evidence that male college students tend to have, on average, more favorable attitudes towards their mothers than fathers (p-value from t-test = .1517, p-value from Wilcoxon Signed-Rank test = .2158).

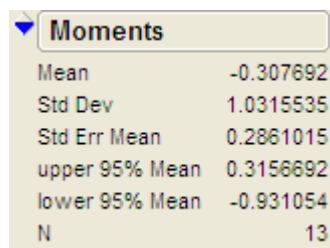c. By hand, verify the test statistic given by JMP.

$$t = \frac{-.3077 - 0}{1.03155 \Big/ \sqrt{13}} = -1.0755$$

d. Construct a 95% confidence interval for the difference in means. Verify this confidence interval from the JMP output.

If you wanted to construct this "by hand":

$$-.3077 \pm 2.179\left(1.03155 \Big/ \sqrt{13} \right) \Rightarrow$$

- .931 $\leq \mu_{\text{father-mother}} \leq$ .316

You can always just use the JMP output:

e. In the context of the problem, interpret the confidence interval from part d.
    We are 95% certain the difference in attitude scores (father-mother) is between -.931 and .316. Since this includes zero, we have no evidence that this difference is not zero.

2. Determine whether each of the following scenarios is an example of a
    dependent/paired sample or an independent sample. Explain your reasoning.

    a. Is autism marked by different brain growth patterns in early life, even before an
        autistic diagnosis is made? Studies have linked brain size in infants and toddlers to
        a number of future ailments, including autism. One study looked at the brain sizes
        of 30 autistic boys and 13 non-autistic boys who all had received an MRI scan as
        toddlers. The whole-brain volume (in ml) was recorded for each boy.
        **Independent – the observations in the two groups (autistic vs. non-autistic) are
        not paired in any natural way.**

    b. Woo and McKenna (*British Journal of Dermatology*, 2003) investigated the effect of
        broadband ultraviolet B (UVB) therapy and topical calcipotriol cream used together
        on area of psoriasis. One of the outcome variables from the study was the Psoriasis
        Area and Severity Index (PASI). The PASI score of twenty subjects were measured
        at baseline and after eight treatments.
        **Dependent – the observations in the two groups (pre-treatment vs. post-
        treatment) are paired according to subject. We should analyze the data with a
        paired t-test to remove the variation due to subject in order to isolate the
        differences between pre-treatment and post-treatment.**

    c. A researcher interviews 64 students in their freshman year and then again in their
        senior year to determine if their opinion has changed regarding their ideal number
        of children.
        **Dependent – the observations in the two groups (freshman vs. senior) are paired
        according to subject. We should analyze the data with a paired t-test to remove
        the variation due to subject in order to isolate the differences that occur from
        freshman to senior year.**

    d. Some archeologists theorize that ancient Egyptians interbred with several different
        immigrant populations over thousands of years. To see if there is any indication of
        changes in body structure that might have resulted, researchers measured the
        breadth (measured in mm) of a random sample of male Egyptian skulls dated from
        4000 B.C. and from 200 B.C. (*Ancient Races of the Thebaid*, 1905).
        **Independent – the observations in the two groups (4000 B.C. vs. 200 B.C.) are not
        paired in any natural way.**