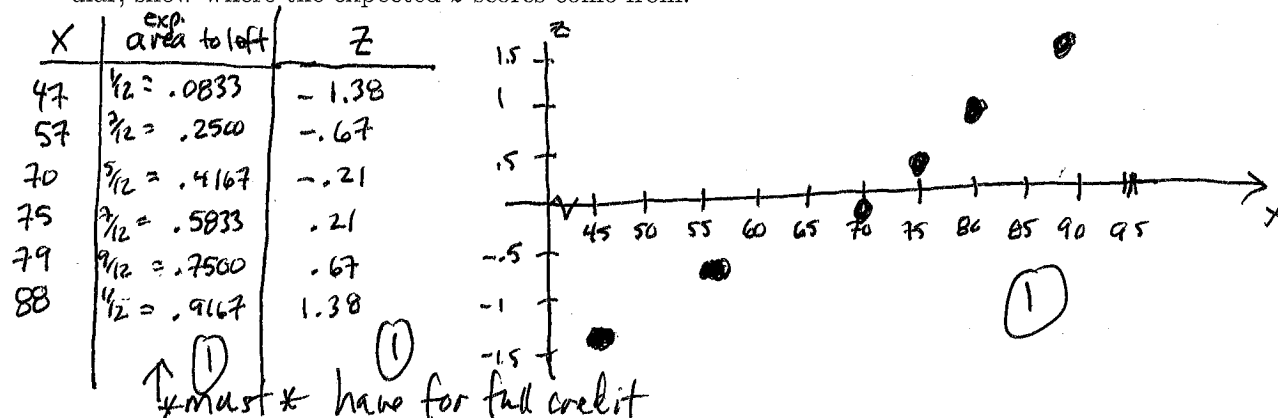


Show relevant work for credit. No work = little or no credit. Unless the problem says otherwise, you must work it by hand and show how to do it, you can use your calculator to *verify* your work.

1. Consider the sample

47, 57, 70, 75, 79, 88.

(a) SHOW HOW and make a normal probability (normal quantile) plot for this data set. In particular, show where the expected z-scores come from.



(b) Is it reasonable to assume that this sample came from a normally distributed population? Explain.

pretty close to a line (lots of flexibility w/ their for a small sample) so could be from normal pop. (1)

2. It is common lore that Avon's Skin So Soft hand lotion is a very effective repellent for black flies (little biting flies in upstate New York). To test this claim volunteers applied fixed amount of a commercial repellent, DEET, (Treatment I), or Skin So Soft hand lotion (Treatment II) to their hand and arm, placing it in a chamber with 50 hungry black flies. The time until first bite in minutes is recorded below.

Treatment I: 14, 6, 8, 7, 15, 18, 12
 Treatment II: 7, 10, 49, 2, 38, 6, 6

These samples are independent. Are the treatments different in their efficacy? Analyze using the Wilcoxon rank-sum test.

$H_0: M_I = M_{II}$ (1)
 $H_1: M_I \neq M_{II}$

I		II	
1.5	2	2	1.5
4	5	3	3
5.5	6	6	5.5
7.5	7	7	7.5
9	8	9	10
12	13	10	11
13	14	38	15
14	15	49	16

$W_x = 66.5$ (1)

$n_x = 8, n_y = 8, W_x = 66.5, W_{crit} = (49, 87)$ (1)

Do not reject H_0 at $\alpha = .05$.

There is not evidence to show a difference in the pop. median length of time until first bite w/ the two different treatments. (1)

3. A report in *Science* summarizing a large Norwegian study claimed that the first-born children have higher IQ's than later born children. To test the hypothesis that birth order influences IQ you decide to do a small study of your own. Thirteen of your friends volunteer to report their scores on a standardized IQ test as well as scores for their siblings. Below is the data:

First-born	Second-born	$d = F - S$
118	109	9
127	120	7
130	131	-1
109	105	4
115	110	5
119	119	0
105	109	-4
117	114	3
135	130	5
143	139	4
111	105	6
128	121	7
135	130	5

d	rank
9	8
7	4.5
-1	1
4	2
5	4.5
4	4.5
4	4.5
4	4.5
5	8
5	8
6	9
7	10
7	11

4's split
3rd through 6th
5's split
7th → 9th

(a) Without assuming anything about the distribution of the population of differences, conduct a sign test to test the claim.

$H_0: M_d = 0, H_a: M_d > 0$ (1) $n = 12$

$S = S_- = 2, P = P(X \leq 2) = \text{binomcdf}(\overset{12}{11}, .5, 2)$
 $= .0193$ (1)

Reject H_0 at $\alpha = .05$ ($p = .0193$). There is evidence to show the median IQ score is larger for first born. (1)

(b) Assume the population of differences is symmetrically distributed and conduct an appropriate test to test the claim.

$H_0: M_d = 0, H_a: M_d > 0$ (1)

$T = T_- = 5.5$, reject H_0 if $T \leq T_{crit} = 17$ ($n=12$) (1)

So Reject H_0 at $\alpha = .05$ (as above).