

- X. Darin wants to compare assembly time of 30-milligram parts using method A and method B. It is not known whether these populations are approximately normal with the same variance. Use the Mann-Whitney test to determine at the .05 level of significance whether these samples come from populations with equal medians.

Time to Assemble 30-Milligram Parts in Seconds											
Method A	90	95	104	88	91	94	87	102	96	98	101
Method B	95	102	93	105	96	99	100	103	91	97	106

Rank			Ranked Scores		Rank			Ranked Scores		Rank			Ranked Scores	
Ordered Array and Assembly Method			Method A	Method B	Ordered Array and Assembly Method			Method A	Method B	Ordered Array and Assembly Method			Method A	Method B
1.	87	A	1		8.	95	A	8.5		15.	100	B		15
2.	88	A	2		9.	95	B		8.5	16.	101	A	16	
3.	90	A	3		10.	96	A	10.5		17.	102	A	17.5	
4.	91	A	4.5		11.	96	B		10.5	18.	102	B		17.5
5.	91	B		4.5	12.	97	B		12	19.	103	B		19
6.	93	B		6	13.	98	A	13		20.	104	A	20	
7.	94	A	7		14.	99	B		14	21.	105	B		21
										22.	106	B		22
Subtotals			17.5	10.5				32.0	45.0				53.5	94.5

$$R_1 = 17.5 + 32.0 + 53.5 = 103$$

$$\begin{aligned}
 U_1 &= n_1 n_2 + \frac{n_1(n_1+1)}{2} - R_1 \\
 &= 11(11) + \frac{11(11+1)}{2} - 103 \\
 &= 121 + 66 - 103 \\
 &= 84
 \end{aligned}$$

$$\begin{aligned}
 \mu_U &= \frac{n_1 n_2}{2} \\
 &= \frac{11(11)}{2} \\
 &= 60.5
 \end{aligned}$$

$$\begin{aligned}
 \sigma_U &= \sqrt{\frac{n_1 n_2 (n_1 + n_2 + 1)}{12}} \\
 &= \sqrt{\frac{11(11)(11+11+1)}{12}} \\
 &= \sqrt{\frac{2,783}{12}} \\
 &= 15.23
 \end{aligned}$$

$$\begin{aligned}
 Z &= \frac{U - \mu_U}{\sigma_U} \\
 &= \frac{84.0 - 60.5}{15.23} \\
 &= 1.543
 \end{aligned}$$

This two-tail problem has a z of  $\pm 1.96$  for the .05 level of significance.  $H_0$  is accepted because  $1.54 < 1.96$ . Median assembly times are equal.