

## Wilcoxon Signed-Rank Test

For  $n = 9$ .

The logic and computational details of the Wilcoxon test are described in Subchapter 12a of [Concepts and Applications](#).

Like the **t**-test for correlated samples, the Wilcoxon signed-ranks test applies to two-sample designs involving repeated measures, matched pairs, or "before" and "after" measures. Beginning with a set of paired values of  $X_a$  and  $X_b$ , this page will

- take the absolute difference  $|X_a - X_b|$  for each pair;
- omit from consideration those cases where  $|X_a - X_b| = 0$ ;
- rank the remaining absolute differences, from smallest to largest, employing tied ranks where appropriate;
- assign to each such rank a "+" sign when  $X_a - X_b > 0$  and a "-" sign when  $X_a - X_b < 0$ ;
- and then calculate the value of **W** for the Wilcoxon test, which in the present version of the procedure is equal to the sum of the signed ranks. The number of signed ranks, here designated as  $n_{s/r}$ , is equal to the number of  $X_a X_b$  pairs with which you begin minus the number of pairs for which  $|X_a - X_b| = 0$ .

When  $n_{s/r}$  is equal to or greater than 10, the sampling distribution of **W** is a reasonably close approximation of the normal distribution. In this case, the present page calculates the appropriate **z**-ratio along with the associated one-tail and two-tail probabilities. For smaller sample sizes ( $n_{s/r} = 5$  through 9), the obtained value of **W** can be referred to the separate table of critical values of  $\pm \mathbf{W}$ .

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### Procedure:

- **Direct Entry into Data Cells:**  
Enter the values of  $X_a$  and  $X_b$  into the cells of the designated columns, beginning in the top-most cell of each column. After each entry, depressing the «tab» key will take you down to the next cell in the column. After all values of  $X_a$  and  $X_b$  have been entered in this fashion, scroll down to the button labeled «Calculate» and click it.
- **Importing Data via Copy & Paste:**  
When importing data from a spreadsheet, the paired values of  $X_a$  and  $X_b$  must be in the

form of two adjacent columns. Within the spreadsheet application, select and copy the two columns of data for  $X_a$  and  $X_b$ . Then return to your web browser, click the cursor into the text area of the Import/Export Box and perform the 'Paste' operation from the 'Edit' menu. After pasting the data, make sure that the final entry is not followed by an extra blank line. To do this, click the cursor immediately to the right of the final entry in the list, then press the down-arrow key. If an extra line is present, the cursor will move downward. Extra lines can be removed by pressing the down-arrow key until the cursor no longer moves, and then pressing the 'Backspace' key (on a Mac platform, 'delete') until the cursor stands immediately to the right of the final entry. After this data-check procedure has been performed, click the line labeled 'Import data to data cells', then click the «Calculate» button.

- If you wish to perform another analysis with a different set of data: click the «Reload» button and enter the new value of n at the prompt.

*Data Entry*

Pairs	Data Cells		S/R of $ X_a - X_b $	Import/Export Box	S/R ="signed rank"																											
	$X_a$	$X_b$		$X_a$ and $X_b$																												
1	38	45	-6.5	<table border="0"> <tr><td>38</td><td>45</td><td>-6.5</td></tr> <tr><td>26</td><td>28</td><td>-2.5</td></tr> <tr><td>29</td><td>27</td><td>+2.5</td></tr> <tr><td>41</td><td>38</td><td>+4</td></tr> <tr><td>36</td><td>40</td><td>-5</td></tr> <tr><td>31</td><td>42</td><td>-9</td></tr> <tr><td>32</td><td>39</td><td>-6.5</td></tr> <tr><td>30</td><td>39</td><td>-8</td></tr> <tr><td>35</td><td>34</td><td>+1</td></tr> </table> <p><a href="#">Clear this box</a></p>	38	45	-6.5	26	28	-2.5	29	27	+2.5	41	38	+4	36	40	-5	31	42	-9	32	39	-6.5	30	39	-8	35	34	+1	<a href="#">Import data to data cells</a>
38	45	-6.5																														
26	28	-2.5																														
29	27	+2.5																														
41	38	+4																														
36	40	-5																														
31	42	-9																														
32	39	-6.5																														
30	39	-8																														
35	34	+1																														
2	26	28	-2.5																													
3	29	27	+2.5																													
4	41	38	+4																													
5	36	40	-5																													
6	31	42	-9																													
7	32	39	-6.5																													
8	30	39	-8																													
9	35	34	+1																													

  

<a href="#">Reload</a>	W=	<input type="text" value="-30"/>		
	$n_{s/r}$ =	<input type="text" value="9"/>	P(1-tail)	P(2-tail)

<a href="#">Reset</a>	z=	---	---	---
<a href="#">Calculate</a>				

*Critical Values of ±W for Small Samples*

	Level of Significance for a			
	Directional Test			
	.05	.025	.01	.005
	Non-Directional Test			
$n_s/r$	--	.05	.02	.01
5	15	--	--	--
6	17	21	--	--
7	22	24	28	--
8	26	30	34	36
9	29	35	39	43

Please note that these small-sample critical values pertain to the version of the Wilcoxon test in which the test statistic,  $W$ , is calculated as the sum of *all* the signed ranks, positive and negative combined. Descriptions of this version of the Wilcoxon test can be found in Subchapter 12a of [Concepts and Applications of Inferential Statistics](#) and in Frederick Mosteller & Robert E. K. Rourke, *Sturdy Statistics: Nonparametrics and Order Statistics*, Addison-Wesley, 1973, 89ff.

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