

Critical Values P. 1

Appendix 1: Method for ranking data in statistical tests

- 1 Organize the data into ascending order of values (see specimen data below).
- 2 Allocate rank 1 to the lowest value.
- 3 Allocate ranks to the remaining values, averaging the ranks for any tied scores (see below).
- 4 A useful check that you have done this correctly is that the last rank value you use should be the same as N , unless, of course, it was tied.

Scores	Rank	Notes
10	1	
12	2.5	Both scores of 12 are given the average rank of positions 2 and 3. Note that the next score is ranked 4, not 3.
12	2.5	
15	4	
17	5	
18	7	The three scores of 18 are each given the average rank of positions 6, 7 and 8, i.e. 7. Note that the next score is rank 9, not 8.
18	7	
18	7	
20	9	
25	10	

Appendix 2: The critical values of U

Table 1: Critical values of U for a one-tailed test at $p = .005$; two-tailed test at $p = .01$ (Mann-Whitney)

N_2	N_1																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	0	0	0	1	1	1	2	2	2	2	3	3
5	-	-	-	-	0	1	1	2	3	4	5	6	7	7	8	9	10	11	12	13
6	-	-	-	0	1	2	3	4	5	6	7	9	10	11	12	13	15	16	17	19
7	-	-	-	0	1	2	3	4	5	6	7	9	10	12	13	15	16	18	19	21
8	-	-	-	0	1	2	3	4	5	6	7	9	10	12	13	15	16	18	19	21
9	-	-	-	0	1	2	3	4	5	6	7	9	10	12	13	15	16	18	19	21
10	-	-	-	0	1	2	3	4	5	6	7	9	10	12	13	15	16	18	19	21
11	-	-	-	0	1	2	3	4	5	6	7	9	10	12	13	15	16	18	19	21
12	-	-	-	0	1	2	3	4	5	6	7	9	10	12	13	15	16	18	19	21
13	-	-	-	0	1	2	3	4	5	6	7	9	10	12	13	15	16	18	19	21
14	-	-	-	0	1	2	3	4	5	6	7	9	10	12	13	15	16	18	19	21
15	-	-	-	0	1	2	3	4	5	6	7	9	10	12	13	15	16	18	19	21
16	-	-	-	0	1	2	3	4	5	6	7	9	10	12	13	15	16	18	19	21
17	-	-	-	0	1	2	3	4	5	6	7	9	10	12	13	15	16	18	19	21
18	-	-	-	0	1	2	3	4	5	6	7	9	10	12	13	15	16	18	19	21
19	-	-	-	0	1	2	3	4	5	6	7	9	10	12	13	15	16	18	19	21
20	-	-	-	0	1	2	3	4	5	6	7	9	10	12	13	15	16	18	19	21

*Dashes in the body of the table indicate that no decision is possible at the stated level of significance. For any N_1 and N_2 , the observed value of U is significant at a given level of significance if it is equal to or less than the critical values shown.

Critical Values P.3

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Table 4: Critical values of U for a one-tailed test at $p = .05$; two-tailed test at $p = .10^*$ (Mann-Whitney)

N_2	N_1																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	3	-	-	-	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
10	4	-	-	0	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8
16	5	-	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
22	6	-	0	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
28	7	-	0	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
34	8	-	1	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
40	9	-	1	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
47	10	-	1	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
53	11	-	1	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
60	12	-	1	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
67	13	-	2	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
73	14	-	2	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
80	15	-	2	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
87	16	-	3	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
93	17	-	3	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
100	18	-	3	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
107	19	-	4	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
114	20	-	4	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22

*Dashes in the body of the table indicate that no decision is possible at the stated level of significance. For any N_1 and N_2 the observed value of U is significant at a given level of significance if it is equal to or less than the critical values shown.
Source: Runyon and Haber (1976)

Appendix 3: The critical values of T for the Wilcoxon Matched Pairs Signed Ranks test

N	Level of significance for a one-tailed test			
	.05	.025	.01	.005
N	Level of significance for a two-tailed test			
	.10	.05	.02	.002
2				
8				
13				
20				
27	5	0		
34	6	2		
41	7	3		
48	8	5	0	
55	9	8	1	0
62	10	10	3	1
69	11	13	5	3
76	12	17	7	5
83	13	21	9	7
90	14	25	12	9
98	15	30	15	12
105	16	35	19	15
112	17	41	23	19
119	18	47	27	23
127	19	53	32	27
	20	60	37	32
	21	67	43	37
	22	75	49	42
	23	83	55	48
	24	91	62	54
	25	100	69	61
			76	68

Value of T that is equal to or less than the tabled value is significant at or beyond the level indicated.
Source: Taken from Table 1 of McCormack (1965) With permission of the publisher.

Critical Values P. 4

Appendix 4: Critical values of Spearman's Rank Order Correlation Coefficient (r_s)

Level of significance for two-tailed test				
	.10	.05	.20	.01
Level of significance for one-tailed test				
N	.05	.025	.01	.005
4	1.000			
5	.900	1.000	1.000	
6	.829	.886	.943	1.000
7	.714	.786	.893	.929
8	.643	.738	.833	.881
9	.600	.700	.783	.833
10	.564	.648	.745	.794
11	.536	.618	.709	.755
12	.503	.587	.671	.727
13	.484	.560	.648	.703
14	.464	.538	.622	.675
15	.443	.521	.604	.654
16	.429	.503	.582	.635
17	.414	.485	.566	.615
18	.401	.472	.550	.600
19	.391	.460	.535	.584
20	.380	.447	.520	.570
21	.370	.435	.508	.556
22	.361	.425	.496	.544
23	.353	.415	.486	.532
24	.344	.406	.476	.521
25	.337	.398	.466	.511
26	.331	.390	.457	.501
27	.324	.382	.448	.491
28	.317	.375	.440	.483
29	.312	.368	.433	.475
30	.306	.362	.425	.467

Values of r_s that equal or exceed the tabled value are significant at or below the level indicated.

Source: Zar (1972)

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Critical Values P.5

Appendix 5: Critical values of χ^2

Level of significance for a one-tailed test						
df	.10	.05	.025	.01	.005	.0005
1	1.64	2.71	3.84	5.41	6.64	10.83
Level of significance for a two-tailed test						
df	.20	.10	.05	.02	.01	.001
1	1.64	2.71	3.84	5.41	6.64	10.83
2	3.22	4.60	5.99	7.82	9.21	13.82
3	4.64	6.25	7.82	9.84	11.34	16.27
4	5.99	7.78	9.49	11.67	13.28	18.46
5	7.29	9.24	11.07	13.39	15.09	20.52
6	8.56	10.64	12.59	15.03	16.81	22.46
7	9.80	12.02	14.07	16.62	18.48	24.32
8	11.03	13.36	15.51	18.17	20.09	26.12
9	12.24	14.68	16.92	19.68	21.67	27.88
10	13.44	15.99	18.31	21.16	23.21	29.59
11	14.63	17.28	19.68	22.62	24.72	31.26
12	15.81	18.55	21.03	24.05	26.22	32.91
13	16.98	19.81	22.36	25.47	27.69	34.53
14	18.15	21.06	23.68	26.87	29.14	36.12
15	19.31	22.31	25.00	28.26	30.58	37.70
16	20.46	23.54	26.30	29.63	32.00	39.29
17	21.62	24.77	27.59	31.00	33.41	40.75
18	22.76	25.99	28.87	32.35	34.80	42.31
19	23.90	27.20	30.14	33.69	36.19	43.82
20	25.04	28.41	31.41	35.02	37.57	45.32
21	26.17	29.62	32.67	36.34	38.93	46.80
22	27.30	30.81	33.92	37.66	40.29	48.27
23	28.43	32.01	35.17	38.97	41.64	49.73
24	29.55	33.20	36.42	40.27	42.98	51.18
25	30.68	34.38	37.65	41.57	44.31	52.62
26	31.80	35.56	38.88	42.86	45.64	54.05
27	32.91	36.74	40.11	44.14	46.96	55.48
28	34.03	37.92	41.34	45.42	48.28	56.89
29	35.14	39.09	42.69	46.69	49.59	58.30
30	36.25	40.26	43.77	47.96	50.89	59.70
32	38.47	42.59	46.19	50.49	53.49	62.49
34	40.68	44.90	48.60	53.00	56.06	65.25
36	42.88	47.21	51.00	55.49	58.62	67.99
38	45.08	49.51	53.38	57.97	61.16	70.70
40	47.27	51.81	55.76	60.44	63.69	73.40
44	51.64	56.37	60.48	65.48	68.71	78.75
48	55.99	60.91	65.17	70.20	73.68	84.04
52	60.33	65.42	69.83	75.02	78.62	89.27
56	64.66	69.92	74.47	79.82	83.51	94.46
60	68.97	74.40	79.08	84.58	88.38	99.61

Calculated value of χ^2 must equal or exceed the table (critical) values for significance at the level shown.
 Source: abridged from Fisher and Yates (1974).

