

**Q-test TEST FOR OUTLIERS (non-parametric)**

	ug/l	sorted	Q
1	14.27		
2	13.43		
3	14.25		
4	14.83		
5	14.64		
6	14.09		
7	15.19		
8	12.93		
9	13.94		
10	11.20		

alpha=  
range=  
Qcrit=

H0.....

$$Q_{exp} = \frac{X_2 - X_1}{X_N - X_1} \qquad Q_{exp} = \frac{X_N - X_{N-1}}{X_N - X_1}$$

N	Q <sub>crit</sub> (CL:90%)	Q <sub>crit</sub> (CL:95%)	Q <sub>crit</sub> (CL:99%)
3	0.941	0.970	0.994
4	0.765	0.829	0.926
5	0.642	0.710	0.821
6	0.560	0.625	0.740
7	0.507	0.568	0.680
8	0.468	0.526	0.634
9	0.437	0.493	0.598
10	0.412	0.466	0.568

**Confidence interval  
for MEDIAN  
(non-parametric distributions)**

<https://www.youtube.com/watch?v=cxUWQCwxQgk>

Find 95%-confidence interval of medians for both samples A and B:

species A	species B
16	34
32	36
37	38
39	45
40	50
41	54
42	56
50	59
82	69
	91

<i>n</i>	<i>j</i>	
$n \leq 5$ : no confidence inte		
6	1	
7	1	
8	1	
9	2	
10	2	
11	2	
12	3	
13	3	
14	3	
15	4	
16	4	
17	5	
18	5	
19	5	
20	6	

$k$	$p$
erval possible.	
6	0.969
7	0.984
7	0.961
8	0.961
9	0.979
10	0.988
10	0.961
11	0.978
11	0.965
12	0.965
12	0.951
13	0.951
14	0.969
15	0.981
15	0.959

**Wilcoxon signed-rank test  
FOR PAIRS (DEPENDENT SAMPLES)**

A new drug for blood pressure correction was tested on 9 patients.  
The pressure was measured before and after application.  
Decide, if there is an effect of the drug!

$$W = \min (W^+ ; W^-)$$

after	84	75	88	91	85	65	71
before	97	72	93	110	95	78	69

differences

abs

rank

)

90	75
115	75

alpha=0.05		
n	one-tailed	double-tailed
6	2	0
7	3	2
8	5	3
9	8	5
10	10	8
11	13	10
12	17	13
13	21	17
14	25	21
15	30	25
16	35	30
17	41	35
18	47	40
19	53	46
20	60	52
21	67	59
22	75	66
23	83	73
24	91	81
25	100	89

### Mann-Whitney U-test

There were selected 11 fields of similar quality. On 5 randomly selected fields a new fertilizer was tested. Yields of wheat obtained in August were: 5.1, 6.7, 5.6, 6.3, 5.9 t/ha and 4.5, 5.4, 4.8, 4.4, 5.3, 5.0 t/ha, respectively. Find, if the fertilizer has an effect.

fertilizer	no fertil.
5.1	4.5
6.7	5.4
5.6	4.8
6.3	4.4
5.9	5.3
	5.0

$$U = n_1 n_2 + \frac{n_1(n_1+1)}{2} - R_1$$



$n_1 \backslash n_2$	2
2	
3	
4	
5	0
6	0
7	0
8	1
9	1
10	1
11	1
12	2
13	2
14	2
15	3
16	3
17	3
18	4
19	4
20	4

d, the rest was kept without the fertilizer.  
esp.



3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
		0	0	0	1	1	1	1	2	2	2	3	3	3	4	4	4
	0	1	2	2	3	3	4	5	5	6	7	7	8	9	9	10	11
0	1	2	3	4	5	6	7	8	9	10	11	12	14	15	16	17	18
1	2	4	5	6	8	9	11	12	13	15	16	18	19	20	22	23	25
2	3	5	7	8	10	12	14	16	17	19	21	23	25	26	28	30	32
2	4	6	8	11	13	15	17	19	21	24	26	28	30	33	35	37	39
3	5	8	10	13	15	18	20	23	26	28	31	33	36	39	41	44	47
3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54
4	7	11	14	17	20	24	27	31	34	37	41	44	48	51	55	58	62
5	8	12	16	19	23	27	31	34	38	42	46	50	54	57	61	65	69
5	9	13	17	21	26	30	34	38	42	47	51	55	60	64	68	72	77
6	10	15	19	24	28	33	37	42	47	51	56	61	65	70	75	80	84
7	11	16	21	26	31	36	41	46	51	56	61	66	71	77	82	87	92
7	12	18	23	28	33	39	44	50	55	61	66	72	77	83	88	94	100
8	14	19	25	30	36	42	48	54	60	65	71	77	83	89	95	101	107
9	15	20	26	33	39	45	51	57	64	70	77	83	89	96	102	109	115
9	16	22	28	35	41	48	55	61	68	75	82	88	95	102	109	116	123
10	17	23	30	37	44	51	58	65	72	80	87	94	101	109	116	123	130
11	18	25	32	39	47	54	62	69	77	84	92	100	107	115	123	130	138

### Kruskal-Wallis test

In 3 samples of crude oils, Ni was determined by AAS. Decide (applying Kruskal-Wallis test), if there is a significant difference among the samples.

Sample							
1	14.2	16.8	19.1	15.5	16	15.9	
2	14.5	20	18	15.4	16.1	17.7	
3	18.3	20.1	17.7	17.9	19.3	16.9	

$$H = \frac{12}{n(n+1)} \left( \frac{R_1^2}{n_1} \right)$$

alpha=0.05



$$H = \frac{12}{n(n+1)} \left( \frac{R_1^2}{n_1} + \frac{R_2^2}{n_2} + \dots + \frac{R_k^2}{n_k} \right) - 3(n+1)$$

6	4	3	5.610
6	4	4	5.681
6	5	1	4.990
6	5	2	5.338
6	5	3	5.602
6	5	4	5.661
6	5	5	5.729
6	6	1	4.945
6	6	2	5.410
6	6	3	5.625
6	6	4	5.725
6	6	5	5.765
6	6	6	5.801
7	7	7	5.819
8	8	8	5.805