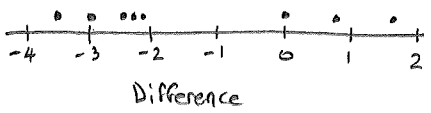
CIMT Further Statistics – p80 Example for Wilcoxon Signed Rank Test

Justification : paired data
no assumptions about parent distribution type

Assumptions : distribution of differences is symmetrical

Draw dotplot of data to inform the analysis

plausible symmetrical distribution.



H_0: median difference = 0 where difference = A − B.

H_1: median difference < 0 (ie. B gives higher scores)

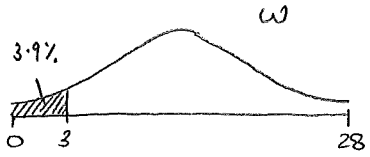
Assume H_0 to be true

$\alpha = 5\%$, 1 tail test

Subject								
method A	11·2	8·6	6·5	17·3	14·3	10·7	9·8	13·3
method B	10·4	12·1	9·1	15·6	16·7	10·7	12·8	15·5
A − B	0·8	−3·5	−2·6	1·7	−2·4	0	−3	−2·2
|A − B|	0·8	3·5	2·6	1·7	2·4	0	3	2·2
rank	1	7	5	2	4		6	3

now $W_+ = 1+2 = 3$
$W_- = 7+5+4+6+3 = 25$ } sum to $28 = \frac{1}{2} \times 7 \times 8$ ✓ check

$W = \min(W_-, W_+) = 3$



smallest value of $W = 0$
largest value of $W = 28$

now, under H_0, each rank is equally likely to be +ve or −ve

we also have $n = 7$ ranks, so there are 2^7 combinations

with 7 nos, what are all the rank sums we can get?

rank	1	2	3	4	5	6	7	
Sum 0								1 way to get 0
1	✓							1 way to get 1
2		✓						1 way to get 2
3	✓	✓						2 ways to get 3
3			✓					
4	✓		✓					2 ways to get 4
4				✓				
5					✓			3 ways to get 5
5	✓			✓				
5		✓	✓					
6						✓		4 ways to get 6
6	✓				✓			
6		✓		✓				
6	✓	✓	✓					

So $P(W \leq 3) = \frac{5}{2^7} = 0.0390625$

At 5% level, this is inside the 5% tail so we have evidence to reject H_0 and conclude that the median difference is less than zero (i.e. method B gives higher scores)