

Statistics by Hand
An Introductory Course for Psychologists

Choose your question

Version 3.0

Types of inference

- Do two groups of people differ **significantly** on a particular measure?
- Do a group of people differ **significantly** on a particular measure collected under two different conditions?
- Is there a **significant** relationship between two different measures of the same group of people?

Group differences

- Do two groups of people differ **significantly** on a particular measure?
- Example
 - **Dependent variable:** vocabulary score
 - **Independent variable:** gender
- Also known as:
 - Between-subjects
 - Unrelated samples
- Statistical tests covered so far:
 - Wilcoxon rank-sum (last lecture)

Dependent variable: The thing being measured.

Independent variable: The factor on which the two groups differ.

“Condition” differences

- Do a group of people differ **significantly** on a particular measure collected under two different conditions?
- Example
 - **Dependent variable:** Reaction time (ms)
 - **Independent variable:** Type of signal (visual or auditory)
- Also known as:
 - Repeated measures
 - Within-subjects
 - Related samples
 - Paired samples
- Statistical tests covered so far:
 - None.

Dependent variable: The thing being measured.

Independent variable: The factor on which the two conditions differ.

Relationships

- Is there a **significant** relationship between two *different* measures of the same group of people?
- Example:
 - **Variable 1:** Height
 - **Variable 2:** Weight
- Also known as:
 - Generally known by the type of test conducted, see later.
- Statistical tests covered so far:
 - None.

New test: Wilcoxon matched-pairs

- A repeated-measures test.
- In other words, it asks:

Do a group of people differ **significantly** on a particular measure collected under two different conditions?

Wilcoxon matched-pairs test

- Hypothesis: Alcohol consumption increases reaction times.
- Design: Simple two-choice reaction time task, before and after consumption of 6 units of alcohol.

	1	2	3	4	5	6	7
Before	330	285	420	281	263	381	550
After	298	687	952	305	263	409	590

Wilcoxon matched-pairs: Logic behind the test

1. Psychological measures are variable
 - You wouldn't expect precisely the same reaction time from a given person on two different occasions.
 - $RT_1 - RT_2$ will not be zero.
2. If alcohol tends to slow RT
 - $RT_1 - RT_2$ will more often be negative than positive.
 - Negative differences should be larger than positive differences.
3. If alcohol has no effect
 - $RT_1 - RT_2$ will be equally likely to be positive as it is to be negative.
 - Negative and positive difference should be about the same size.
4. Wilcoxon matched-pairs calculates a number representing the extent to which (2) is true.
5. Wilcoxon matched-pairs table tell us whether the difference is **statistically significant**.

Wilcoxon matched-pairs test

1. Calculate the difference between each pair.

	1	2	3	4	5	6	7
Before	330	285	420	281	263	381	550
After	298	687	952	305	263	409	590
Difference	-32	402	532	24	0	28	40

Wilcoxon matched-pairs test

2. Remove pairs whose difference is zero
 - Reduce n accordingly
3. Rank the differences, ignoring the sign

	1	2	3	4	5	6	7
Before	330	285	420	281	263	381	550
After	298	687	952	305	263	409	590
Difference	-32	402	532	24	0	28	40
Rank	3	5	6	1		2	4

Wilcoxon matched-pairs test

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4. Calculate the sum of the ranks of the positive differences
 - $T^+ = 5 + 6 + 1 + 2 + 4 = 18$
5. Calculate the sum of the ranks of the negative differences:
 - $T^- = 3$
6. Let T be the smaller of T^+ and T^- . ($T = 3$)

Wilcoxon matched-pairs test

7. The result is significant if T is smaller or equal to the appropriate value in a Wilcoxon matched-pairs table.

Tied Ranks

- To rank a set of numbers such as (23, 25, 25, 30, 87), you give each of the 'tied' numbers the average rank: (1, 2.5, 2.5, 4, 5).