

Non-parametric tests

Part 2

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Non-parametric tests

Learning objectives

- Criteria for choosing a non-parametric test
- Non-parametric tests

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Non-parametric tests

Kruskal-Wallis One-Way Analysis of Variance

- For more than two independent samples
- Analogue of ANOVA for independent samples
- Basic idea: Similar to Wilcoxon test only sum of ranks for more than two groups

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Example

- Sample 1: 4, 9, 10, 11
- Sample 2: 13, 14, 15, 16
- Sample 3: 17, 18, 19, 20

Score	4	9	10	11	13	14	15	16	17	18	19	20
Rank	1	2	3	4	5	6	7	8	9	10	11	12

- Sum of Ranks:
 - Sample 1: 10
 - Sample 2: 26
 - Sample 3: 42

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Inferences from test

- If sums of ranks are similar, H_0 is accepted
- If sums of ranks are dissimilar, H_0 is rejected
- p-value is given by $\chi^2(df)$
- $df = \text{number of groups} - 1$

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Experiment

- Influence of drugs on motivation
- Measured through the number of arithmetic problems solved in an hour
- Three condition: placebo, depressant drug and stimulant drug
- Between-participants design

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Descriptive statistics

Depressant

- Sample size: 7
- Mean: 30.0
- Std. dev.: 28.17
- Median: 44.0

Stimulant

- Sample size: 8
- Mean: 72.1
- Std. dev.: 12.39
- Median: 71

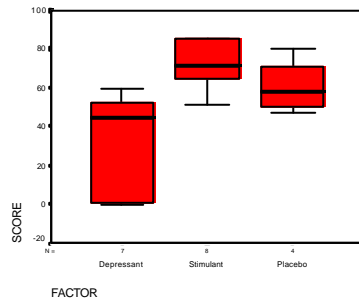
Placebo

- Sample size: 4
- Mean: 60.5
- Std. dev.: 14.20
- Median: 57.5

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Box plot



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Why non-parametric test?

- sample size small for placebo
- Standard deviation too different between depressant and stimulant
- Depressant and stimulant skewed

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Result

Depressant		Stimulant		Placebo	
Score	Rank	Score	Rank	Score	Rank
44	4	73	15	61	11
55	9	85	18	54	8
0	1.5	51	7	80	16
1	3	63	12	47	5
0	1.5	85	18		
50	6	85	18		
60	10	66	13		
		69	14		
Sum:	35		115		40

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SPSS output

SCORE	FACTOR	N	Mean Rank
1.00		7	5.00
2.00		8	14.38
3.00		4	10.00
Total		19	

	SCORE
Chi-Square	10.407
df	2
Asymp. Sig.	.005

Relevant
P-value

a. Kruskal-Wallis Test

b. Grouping Variable: FACTOR

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Report

- A Kruskal-Wallis one-way ANOVA was performed on the results from the three groups. The analysis indicated a significant effect ($\chi^2(2) = 10.41, p = 0.005$).

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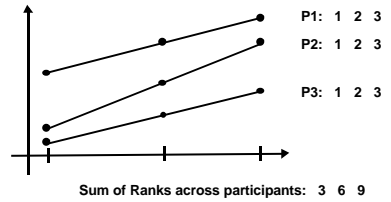
Friedman's Rank Test

- For more than two related samples
- Analogue of repeated-measure ANOVA
- Basic idea: Ranking within each participant and sum of ranks for each condition across participants

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within-participants ranking

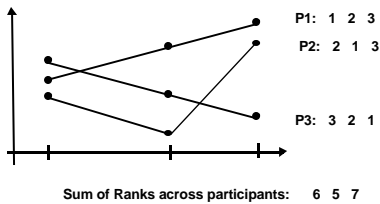


If sums are different than there is an effect

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within-participants ranking



If sums are similar than there is no effect

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Inferences from test

- If sums of ranks are similar, H_0 is accepted
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- p-value is given by $\chi^2(df)$
- $df = \text{number of groups} - 1$

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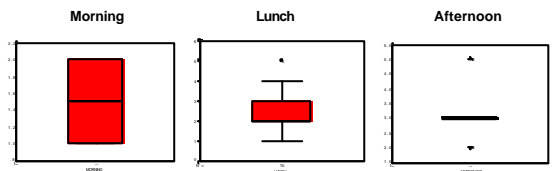
Experiment

- How alert do people feel at various times of the day?
- 10 participants had to rate on a scale between 1 and 5 how alert they felt
- Within-participants design

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Descriptive statistics



- | | | |
|--|---|---|
| <ul style="list-style-type: none"> • Sample size: 10 • Mean: 1.5 • Std. dev.: 0.53 • Median: 1.5 | <ul style="list-style-type: none"> • Sample size: 10 • Mean: 2.5 • Std. dev.: 1.27 • Median: 2.00 | <ul style="list-style-type: none"> • Sample size: 10 • Mean: 3.2 • Std. dev.: 1.03 • Median: 3.00 |
|--|---|---|

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Why non-parametric test?

- Standard deviation too different between morning and lunch
- Lunch slightly skewed
- Outliers in lunch and afternoon

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Results

Participant	Morning	R	Lunch	R	Afternoon	R
1	1	1	2	2	3	3
2	2	1	4	2	5	3
3	1	1	2	2.5	2	2.5
4	2	2	1	1	3	3
5	1	1	3	2.5	3	2.5
6	2	1	5	2.5	5	2.5
7	1	1	2	2	3	3
8	2	2	2	2	2	2
9	1	1	3	2.5	3	2.5
10	2	2	1	1	3	3
Sum of Ranks:		13		20		27

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SPSS output

	Mean Rank
MORNING	1.30
LUNCH	2.00
AFTERNOO	2.70

N	10
Chi-Square	12.250
df	2
Asymp. Sig.	.002

Relevant
P-value

^a. Friedman Test

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Report

- A Friedman's Rank Test was performed on the results and revealed a significant effect ($\chi^2(2) = 12.25, p = 0.002$).

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