

Results

One-way subject design

		Reality	
		No difference Ho is true	Difference H1 is true
Your decision	Difference	Type I Error: Liberal	No error
	No difference	No error	Type II error: Conservative

Population

Sample

Variability due to:

Signal: Treatment (IV)
 Noise: "Chance": Individual Differences
 Or repeated measures effect
 (Interaction Subjects X I.V.)

t test

t ratio = (Signal & Noise) / Noise
 critical t value
 – sampling distribution

F test (F=t²)

F ratio = (Signal & noise) / Noise
 critical F value
 – sampling distribution

Probability? / chance?

Between subject design

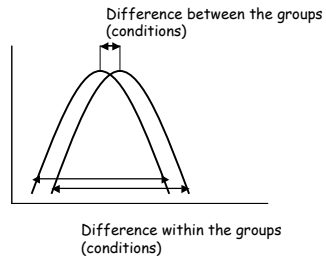
Individual differences

Within subject design

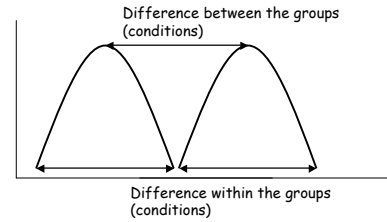
Repeated measures:

Interaction participants X IV

Is there a significant difference?



Is there a significant difference?



Hypotheses

Evaluated by statistical tests

$H_0 \Rightarrow$ **Null Hypothesis**

No "difference" between Gr. A and B

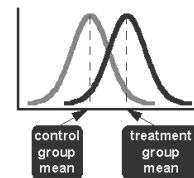
$H_1 \Rightarrow$ **Alternate Hypothesis**

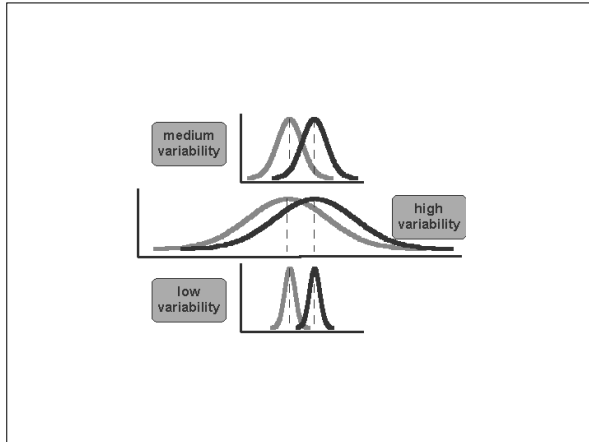
Difference between groups

• In one specific direction:
Gr. A > Gr. B or Gr. A < Gr. B \rightarrow **One-tailed test**

• In any direction \rightarrow **Two-tailed test**

t test: comparing 2 groups





t test

$$\frac{\text{signal}}{\text{noise}} = \frac{\text{difference between group means}}{\text{variability of groups}}$$

$$= \frac{\bar{X}_T - \bar{X}_C}{SE(\bar{X}_T - \bar{X}_C)}$$

$$= \text{t-value}$$

$$SE(\bar{X}_T - \bar{X}_C) = \sqrt{\frac{\text{var}_1}{(n_1 - 1)} + \frac{\text{var}_2}{(n_2 - 1)}}$$

Standard Deviation

$$\sqrt{\frac{\sum(X - \bar{X})^2}{(n - 1)}}$$

where:

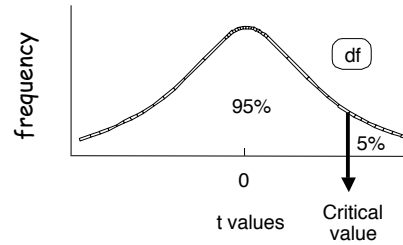
- X = each score
- \bar{X} = the mean or average
- n = the number of values
- Σ means we sum across the values

$$t = \frac{\bar{X}_T - \bar{X}_C}{\sqrt{\frac{\text{var}_1}{(n_1 - 1)} + \frac{\text{var}_2}{(n_2 - 1)}}$$

Variability due to:
 Signal: Treatment (IV)
 Noise: "Chance": Individual Differences
 Or repeated measures effect
 (interaction Subjects X IV)

t test
 $t \text{ ratio} = (\text{Signal \& Noise}) / \text{Noise}$
 critical t value
 – sampling distribution

t values from sampling distribution



Variability due to:
 Signal: Treatment (IV)
 Noise: "Chance": Individual Differences
 Or repeated measures effect
 (interaction subjects X IV)

t test
 $t \text{ ratio} = (\text{Signal \& Noise}) / \text{Noise}$
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 – sampling distribution

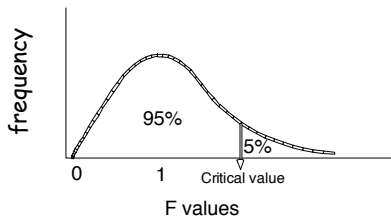
F test
 $F \text{ ratio} = (\text{Signal \& noise}) / \text{Noise}$
 critical F value
 – sampling distribution

F test: a ratio of variance

$$F = \frac{s_1^2}{s_2^2}$$

Variance between groups (conditions) ↗
 ↘
 Variance within groups (conditions)

F values from sampling distribution



Analysis of Variance

Equivalent to t test ($t^2=F$)

Assumptions underlying the use of t test & F test

- Errors are independent
- Errors are identically distributed (homogeneity of variance)
- Errors are normally distributed

Regression analysis Example: One-Way Analysis of Variance (ANOVA) - 3 levels

Group	Group 1	Group 2	Group 3	Mean
1	1	1	1	0.33
2	1	1	1	0.33
3	1	1	1	0.33
4	1	1	1	0.33
5	1	1	1	0.33
6	2	2	2	0.67
7	2	2	2	0.67
8	2	2	2	0.67
9	3	3	3	1.00
10	3	3	3	1.00
11	3	3	3	1.00
Mean	0.33	0.67	1.00	
S.E.	0.33	0.33	0.33	Mean total 0.5

Formulas

Sum of squares (SS)	Sum of squares (SS)
Between Groups $SS = \sum (P_{group} - \bar{P}_{grand})^2$ where P = all individual scores	SS of Groups = 1
Within Group $SS = \sum (P_i - \bar{P}_{group})^2$ where P_i = single score	SS of Groups (if all individual scores) = 11
Total $SS = \sum (P_i - \bar{P}_{grand})^2$ where P_i = single score	SS of scores = 1

Sum of squares	Between groups	SS/df	Mean square	F	p
Between Groups	10.111	11	0.919	10.000	0.0000
Within Groups	0.889	11	0.0808		
Total	11.000	22			

**White Noise (Regarded-Residual) Design:
One-Way Analysis of Variance (ANOVA) -- 3 levels**

	Condition 1	Condition 2	Condition 3	Mean
	0	0	0	0.0
	0	0	0	0.0
	0	0	0	0.0
	0	0	0	0.0
Mean	0.00	0.00	0.00	
S. D.	0.00	0.00	0.00	Mean over 0.0

Manipulations

Form of equation (M)	Degrees of freedom (Df)
Total MS = $\sum (Y - \bar{Y}_{total})^2$ where Y = single case	N of cases - 1
Residual MS = $\sum (Y_{condition} - \bar{Y}_{total})^2$ where Y = N of conditions	N of Subjects - 1
Condition MS = $\sum (N \cdot \bar{Y}_{condition} - \bar{Y}_{total})^2$ where N = N of subjects	N of Conditions - 1
Interaction MS = Total MS - Residual MS - Conditions MS	(N of Conditions - 1)(N of Subjects - 1)

Form of equation	Regarded-Residual	Residual	Condition	Interaction	Total
Residual MS (per)	0.00	0	0.00		
White Noise					
Conditions (per case)	0.00	0	0.00	0.00	0.0000
Conditions N Subjects (per case)	0.00	0	0.00		
Total	0.00	0			

One-Way Residual's analysis vs. One-Way ANOVA analysis

	01	02	03
	0	0	0
	0	0	0
	0	0	0
	00	00	00

Table of contents - Release subjects					
Release	2018	2019	2020	2021	2022
Release (1)	1.0	1	1.00	1.00	1.00
Release	100.0	1	10.00		
Total	100	11			

Table of contents - Release subjects					
Release	2018	2019	2020	2021	2022
Release subjects	100	1			
Release subjects					
Release (1)	1.0	1	1.00	1.00	1.00
Release (2)	1.0	1	1.00		
Total	100	11			