
MY RESULT WAS THIS SIGNIFICANT
BUT DID CORRECT
FOR MULTIPLE TESTING?
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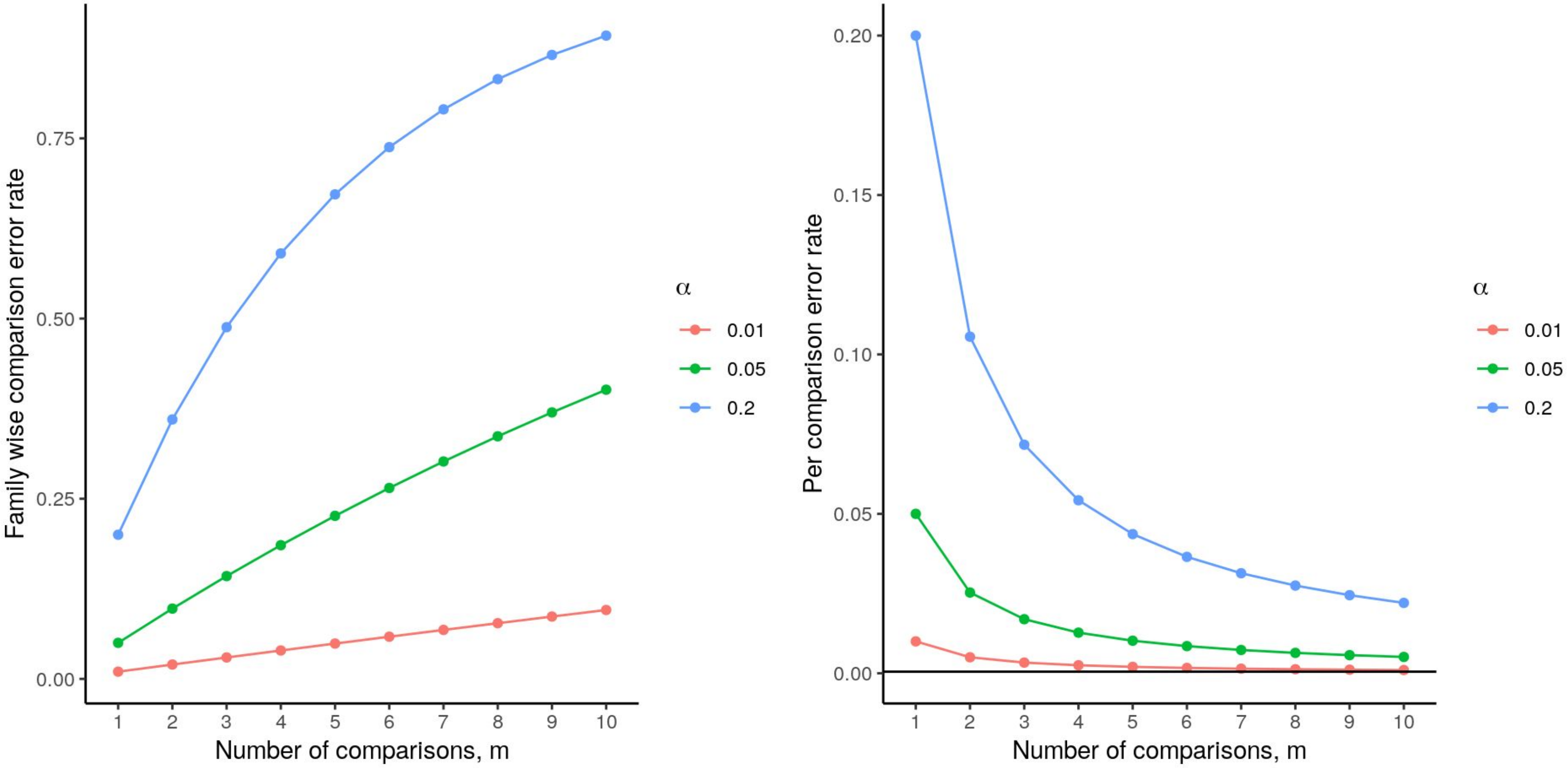
Multiple comparison

- **Familywise error rate (FWER):** the risk of making at least one Type I error (false positive) among the family of comparisons in the experiment
- **Per comparison error rate (PCER):** the probability of a Type I error in the absence of any multiple hypothesis testing correction
- **False Discovery Rate (FDR)** controls the expected (mean) proportion of false discoveries among the R (out of m) hypotheses declared "*significant*"



Family wise comparison error rate
0.00
0.25
0.50
0.75
Number of comparisons, m
1
2
3
4
5
6
7
8
9
10
α
0.01
0.05
0.2
Per comparison error rate
0.00
0.05
0.10
0.15
0.20
Number of comparisons, m
1
2
3
4
5
6
7
8
9
10
α
0.01
0.05
0.2

Calculating (95%) confidence intervals

Typically...

- Upper bound = estimate + (scale factor X SE)
- Lower bound = estimate - (scale factor X SE)

Now, imagine our quantity of interest is the difference between means...

- Upper bound = difference + (scale factor X SED)
- Lower bound = difference - (scale factor X SED)

Choice of scale factor 😟😟

1. Fisher's

2. Bonferroni's

3. Tukey's

Fisher's Least Significant Difference (LSD)

Scale factor: $t_{\alpha=\frac{\alpha_c}{2},\mathrm{df}=N-m}$

LSD: $t_{\alpha=\frac{\alpha_c}{2},\mathrm{df}=N-m}$ X SED

CI: Difference $\pm$ $t_{\alpha=\frac{\alpha_c}{2},\mathrm{df}=N-m}$ X SED

N is the number of observations

m is the number of treatment groups

α_c is the PCER

Bonferroni correction

Scale factor: $t_{\alpha=\frac{\alpha_C}{2\times k},\mathrm{df}=N-m}$

LSD: $t_{\alpha=\frac{\alpha_C}{2\times k},\mathrm{df}=N-m}$ X SED

CI: Difference $\pm$ $t_{\alpha=\frac{\alpha_C}{2\times k},\mathrm{df}=N-m}$ X SED

N is the number of observations

m is the number of treatment groups

α_C is the PCER

$k = \binom{m}{2}$ is the number of pairwise comparisons being made

Tukey's Honest Significant Difference (HSD)

HSD: $$\frac{q_{1-\alpha_c, m, \mathrm{df}=N-m}}{\sqrt{2}} \times \sqrt{\frac{2\hat{\sigma}^2}{n}}$$

CI: Difference $$\pm \quad \frac{q_{1-\alpha_c, m, \mathrm{df}=N-m}}{\sqrt{2}} \times \sqrt{\frac{2\hat{\sigma}^2}{n}}$$

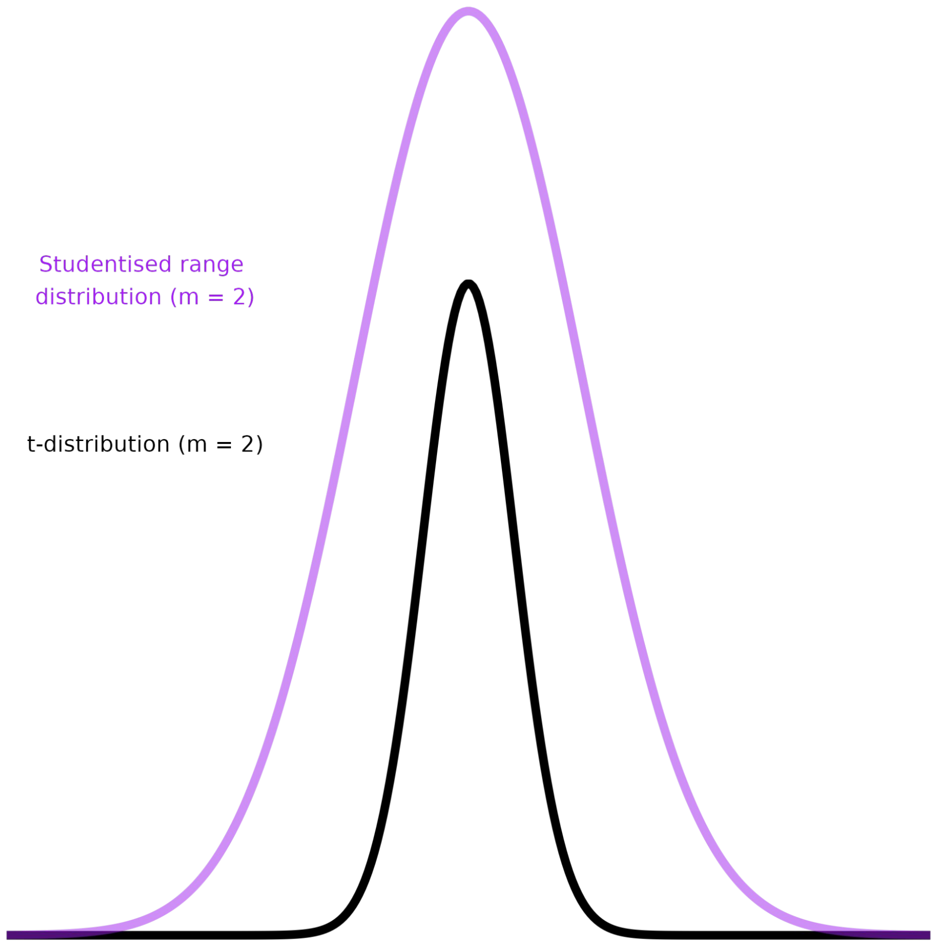
N is the number of observations

m is the number of treatment groups

α_c is the PCER

n is the assumed equal number of replicates in each group

$\hat{\sigma}^2$ is the residual mean square error


Studentised range
distribution (m = 2)
t-distribution (m = 2)