Balancing power analysis with methodology: the unusual (?) case of small sample size

✚ Statistics clinic @Psicostat!!

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Advantages of Power Analysis

Increased Statistical Power

Higher probability of detecting true effects if they exist

Precision

Estimate the required sample size to achieve a desired level of precision in their results

Resource and Ethical Efficiency

Prevents oversampling, optimizing the allocation of time and resources

Limitations of Power Analysis

Methods

Samples should be representative of the population

Sensitivity to Assumptions

Small changes in assumptions can lead to significant changes in sample size estimates

Complex Designs

Challenging for studies with complex designs or multiple outcomes

Stopping Rule
for statistical reasons…

With large sample sizes, even **small differences** between groups can lead to statistically significant results due to

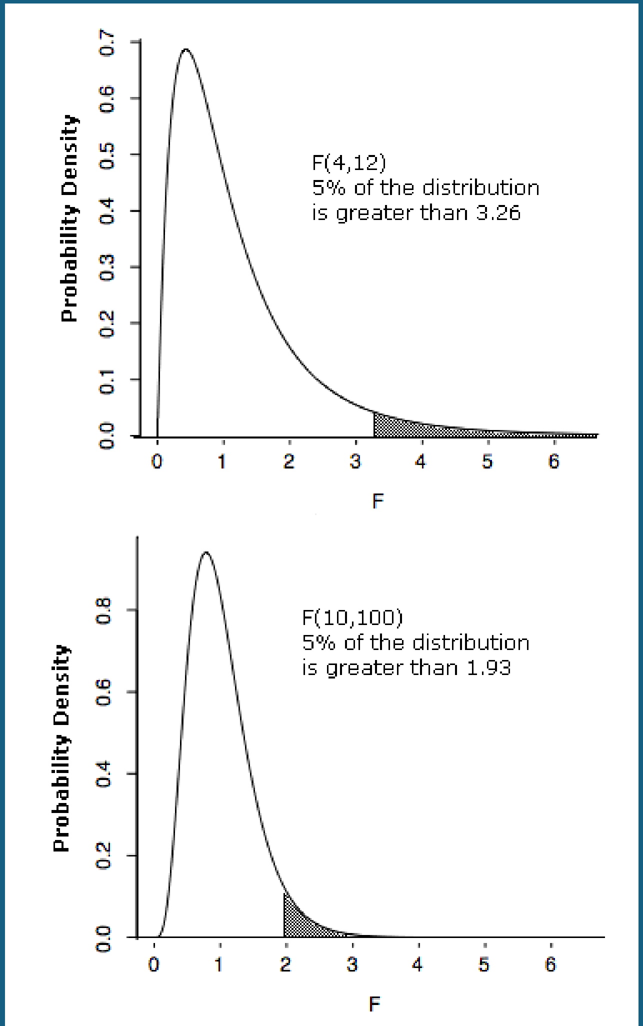
- increased precision

- reduced variability

More likely for the observed difference to be deemed statistically significant

(p-value is calculated based on the standard error of the estimate, which decreases with larger sample sizes)

WITH LARGER SAMPLE SIZES, THE STATISTICAL TEST BECOMES MORE SENSITIVE TO DETECTING DIFFERENCES, EVEN IF THOSE DIFFERENCES ARE SMALL IN MAGNITUDE



Large sample size → narrower distribution

Central Limit Theorem

the sampling distribution approaches a normal distribution as the sample size increases

The small sample size problem

RStudio

power analysis.R*

```r
# POWER
require(pwr)

# ANOVA
# pwr.anova.test(k = , n = , f = , sig.level = , power = )
# Given any three, we can determine the fourth.
# where k is the number of groups and n is the common sample size in each group.
# Cohen suggests that f values of 0.1, 0.25, and 0.4 represent small, medium, and large e
pwr.anova.test(k = 4, f = 0.59, sig.level = .05, power = .8)
```

Console

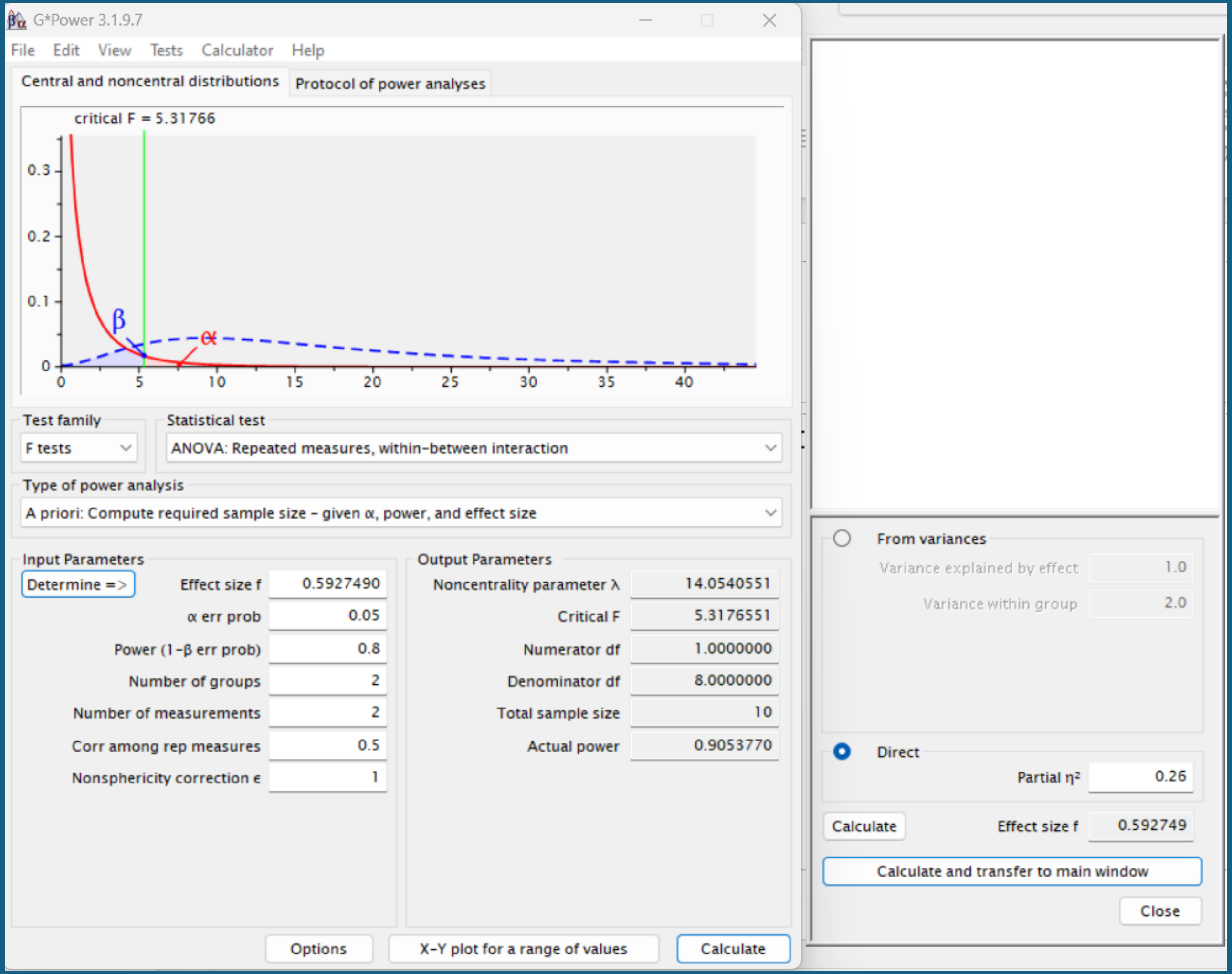
R 4.2.2 · C:/Users/Sara/OneDrive - Alma Mater Studiorum Università di Bologna/Neuro&Ricerca/R/

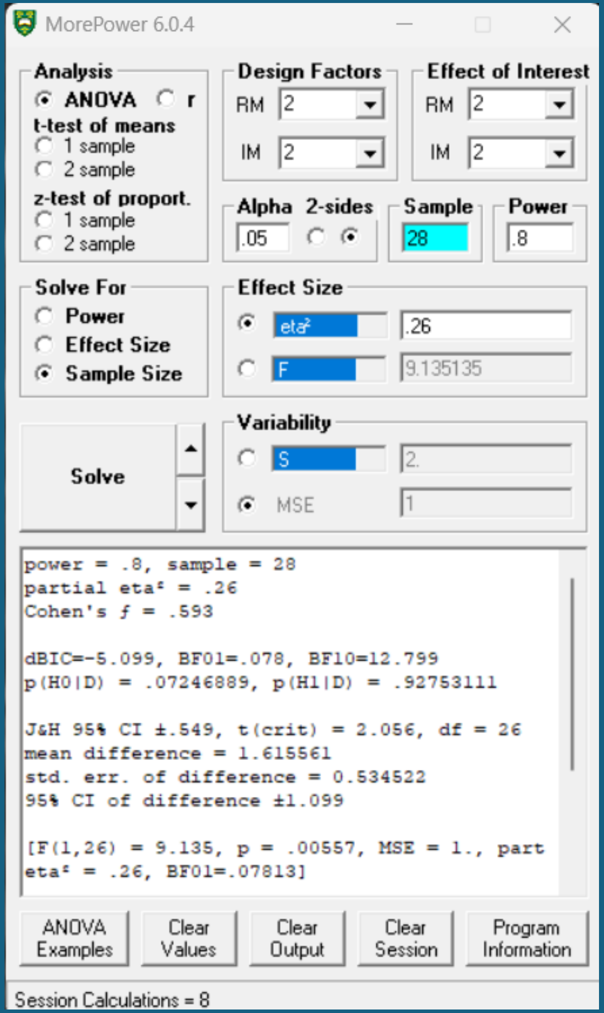
```
     Balanced one-way analysis of variance power calculation

              k = 4
              n = 8.870428
              f = 0.59
      sig.level = 0.05
          power = 0.8

NOTE: n is number in each group
```

The small sample size problem





Useflul links

- https://www.memoryandlearninglab.it/wp-content/uploads/2024/02/Intro-interaction-workshop.html

- https://cran.r-project.org/web/packages/Superpower/vignettes/intro_to_superpower.html