

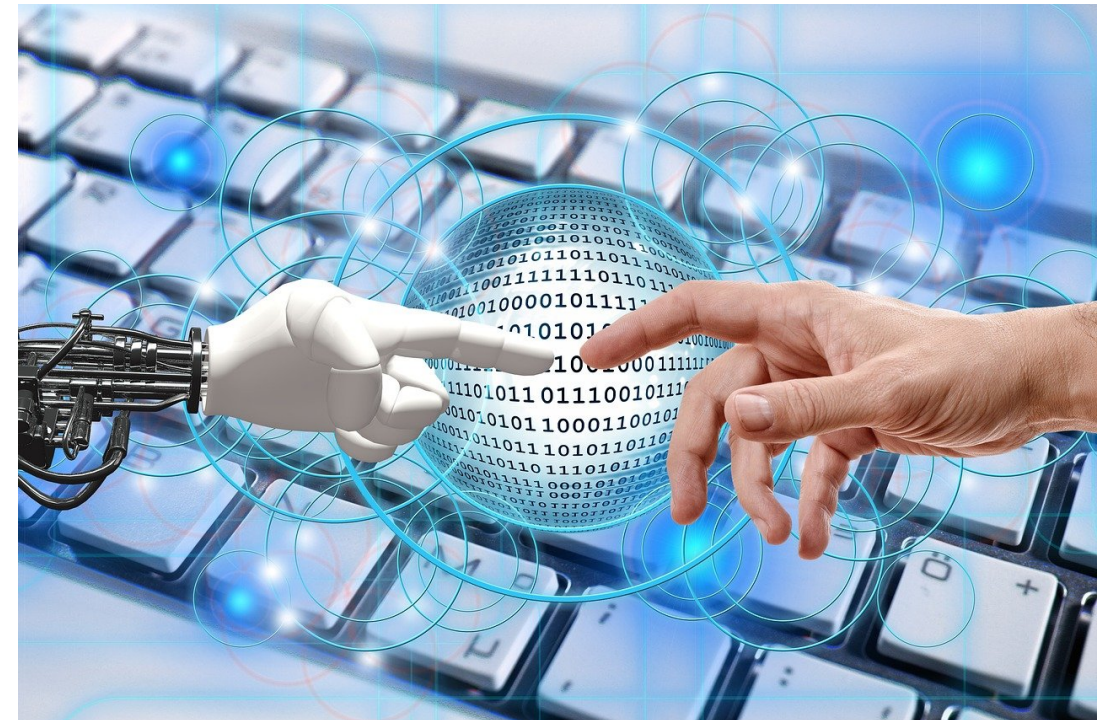
# Tutorial – Power Analysis

Prof. Dr. Teena Hassan  
teena.hassan@h-brs.de

Department of Computer Science

Hochschule Bonn-Rhein-Sieg  
Sankt Augustin

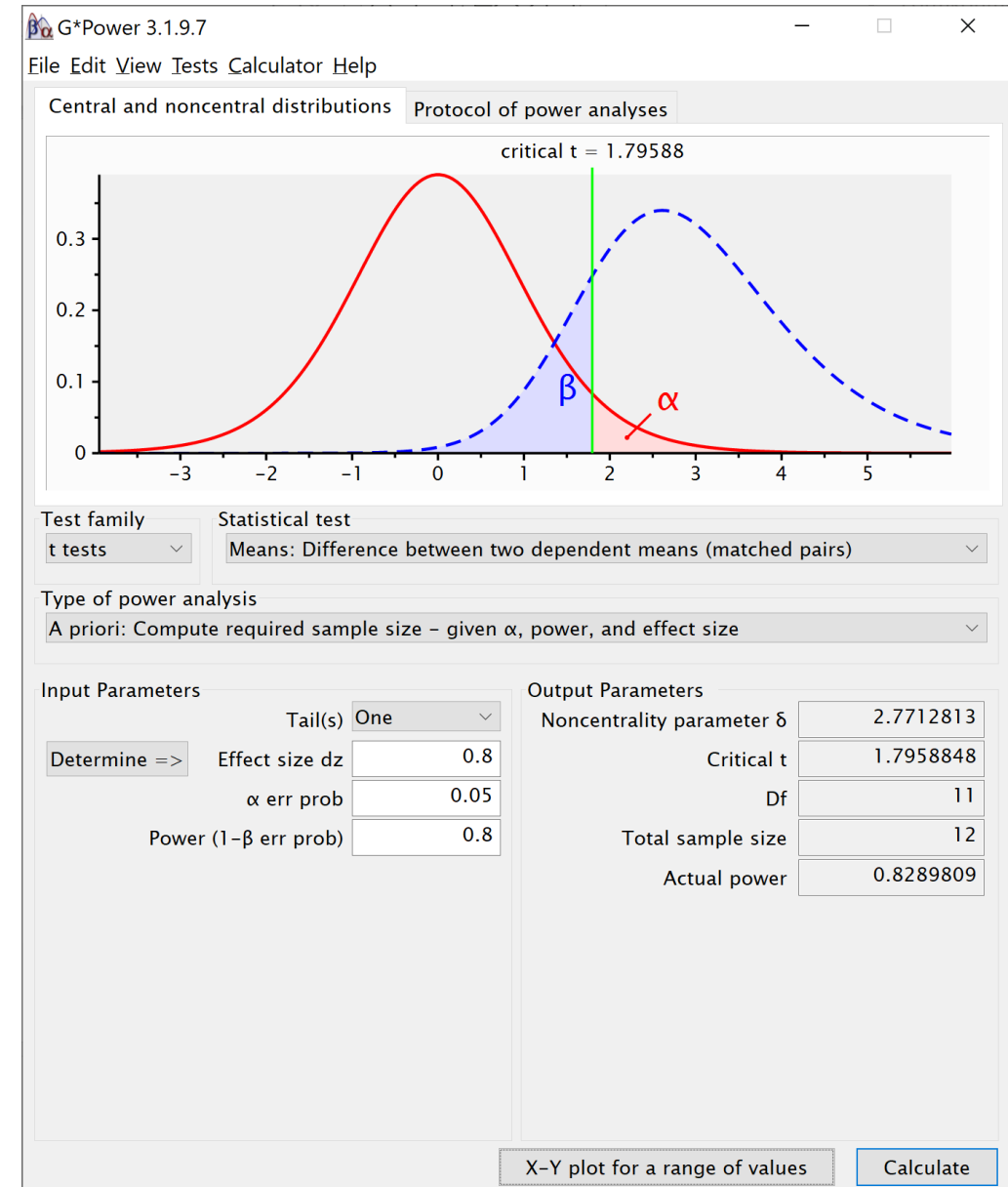
27 June 2024



- Libraries and software for power analysis
- More on power analysis and hypothesis testing
- Revision quiz on conducting HRI experiments
- Two Jupyter notebooks for self-study and preparation for next lecture
  - Descriptive statistics
  - Drawing graphs

# G\*Power

- ♦ A tool (software) for power analysis from Uni Düsseldorf.
- ♦ Only on Windows and macOS!



- Python library: *statsmodels*
  - <https://www.statsmodels.org/dev/stats.html#power-and-sample-size-calculations>
- Demo (Jupyter notebook — for lecturer only; not for upload in LEA)



	Reject H0 Accept H1	Accept H0 Reject H1
H0 is True H1 is False	$\alpha$ False positive rate (Type I error)	$1 - \alpha$ True negative rate
H0 is False H1 is True	$1 - \beta$ True positive rate <b>(POWER)</b>	$\beta$ False negative rate (Type II error)



Holds in the general population



Holds in the sampled population



- [https://wise1.cgu.edu/power/power\\_sample.asp](https://wise1.cgu.edu/power/power_sample.asp)
- <https://www.geo.fu-berlin.de/en/v/soga-r/Basics-of-statistics/Hypothesis-Tests/Introduction-to-Hypothesis-Testing/Critical-Value-and-the-p-Value-Approach/index.html>
- **Important:** We accept or reject hypotheses based on the critical-value or p-value approach. However, it is important to report the post-hoc statistical power of the experiment.

- Independent t-test

- Between subject
  - Two separate groups of subjects A and B
  - Each group exposed to only one condition
  - Two sampling distributions
- Computes means of dependent variable in either distribution:  $\mu_A$ ,  $\mu_B$
- Difference between means:  $\Delta = \mu_A - \mu_B$
- Effect: Compares  $\Delta$  to zero.
- Effect size (Cohen's d):  $\Delta / \sigma_{pooled}$

- Paired t-test

- Within subject
  - One group of subjects
  - Each subject exposed to both conditions A and B
- One sampling distribution S based on difference  $\Delta_s$  in response of each subject s in condition A and condition B.
  - $\Delta_s = a_s - b_s$
  - $\mu_S = \text{Mean } \Delta_s \text{ over all } s$
- Effect: Compares  $\mu_S$  to zero.
- Effect size (Cohen's d):  $\mu_S / \sigma_S$

$$\sigma_{pooled} = \sqrt{(\sum (a - \mu_A)^2 + \sum (b - \mu_B)^2) / (n_A + n_B - 2)}$$

- Time: 12 mins
- Please enter your first and last name.
- Registration is not possible after the start of the test.
- Preferably, use Chrome as browser.
- Do not close, refresh or reload the page!
  - It would not be possible to enter the exam again.
  - Answers will not be saved!
- Do not forget to click „log in your answer“.
- Finally, click Submit.
- Participation is voluntary.
- Link to quiz: <https://u.quizacademy.io/EAGEMX>





- Excellent resources prepared by Ethan Weed, based on the book “Learning Statistics with R” by Danielle Navarro.
- <https://ethanweed.github.io/pythonbook/landingpage.html>
- Please go through the notebooks on “Descriptive Statistics” and “Drawing Graphs”.
  - Have been uploaded under Tutorials in LEA.
  - Would be helpful to understand the next class.