Comparing Two Means:
Sample size estimation based on power analysis

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- Ingredients
- T test, independent group with balanced design
- G*Power
- R
- Varying signal-to-noise ratio
- Varying signal and noise
- Sample size estimation: reality check…

Ingredients

- minimum difference amongst treatment levels to be detected
- what is relevant for you
- **you decide** (your expertise, your judgement)

→ Effect size (δ)
Signal

- variability in your Eus
- **you find out**
- previous studies
- pilot study
- **systematic review**
- **meta analysis**

→ Population variability (σ or SD)
Noise

Power $1 - \beta$
(typically 0.80 – 0.90)

Level α
(typically 0.05)

Side of H_1 test
Recommend: two-sided

→ $\boldsymbol{n}$

Take α fixed and two-sided test

$$\sqrt{n} \propto \frac{\textbf{power}}{\textbf{signal/noise}}$$

Signal-to-noise ratio is called:

- standardized effect size
- or Cohen's $\boldsymbol{d}$

T test (independent group, equal size n)

$$n = \frac{\sigma^2}{\delta^2}\, 2\,\left(t_{2n-2,1-\alpha/2} + t_{2n-2,1-\beta,c}\right)^2$$

with non-centrality parameter $c = \frac{\delta}{\sigma}\sqrt{n/2}$

G*Power

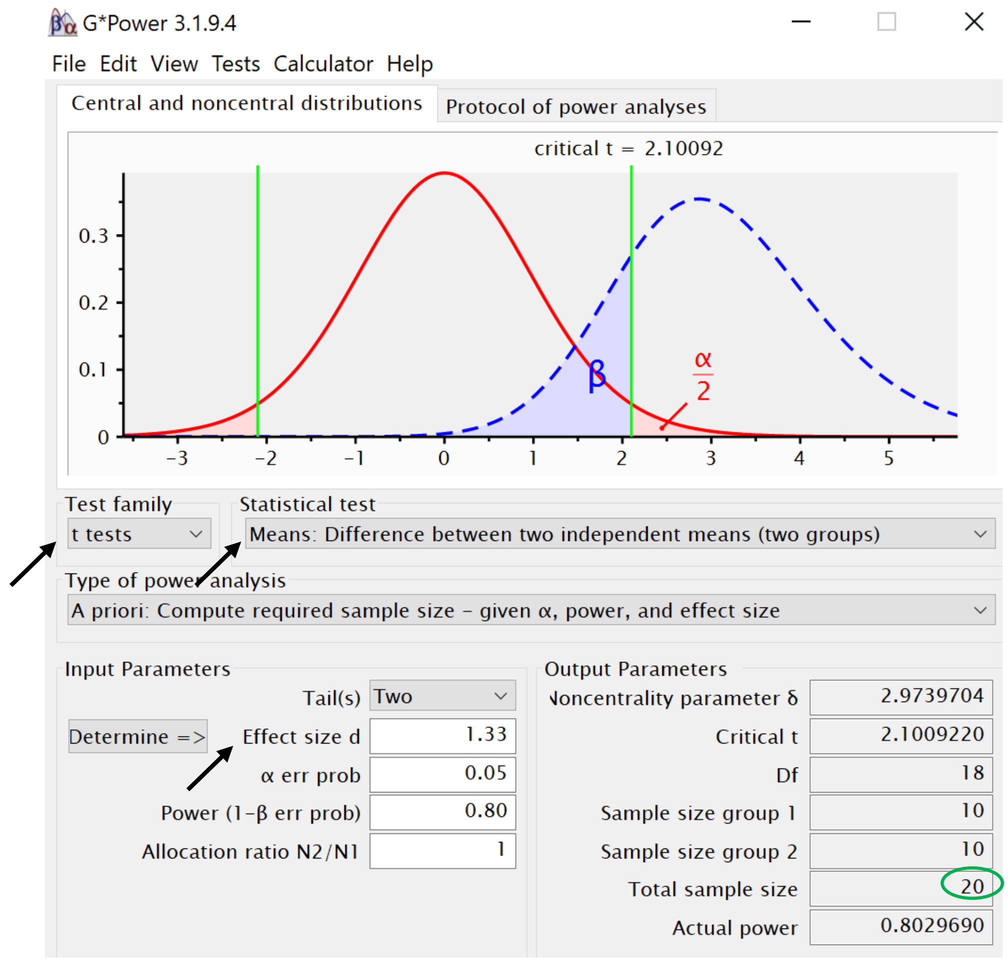
Example

Outcome: *body_fat_%*

Sig. level $\alpha = 0.05$
Power $1 - \beta = 0.80$
Two-sided test
Signal = effect size = $\delta = 8$
Noise = pop variation = $\sigma = 6$

Cohen's $d = \frac{\delta}{\sigma} = \frac{8}{6} = 1.33$

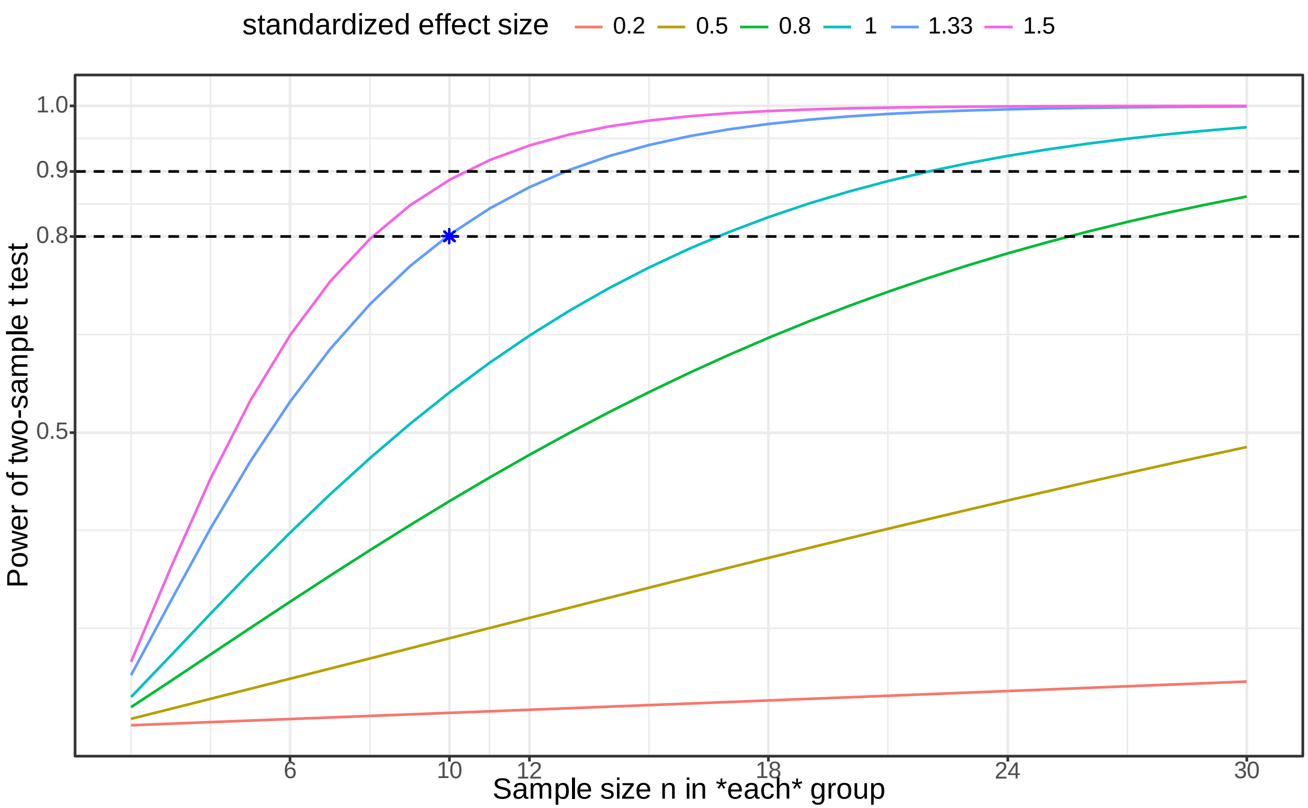
n = 10 each group



R

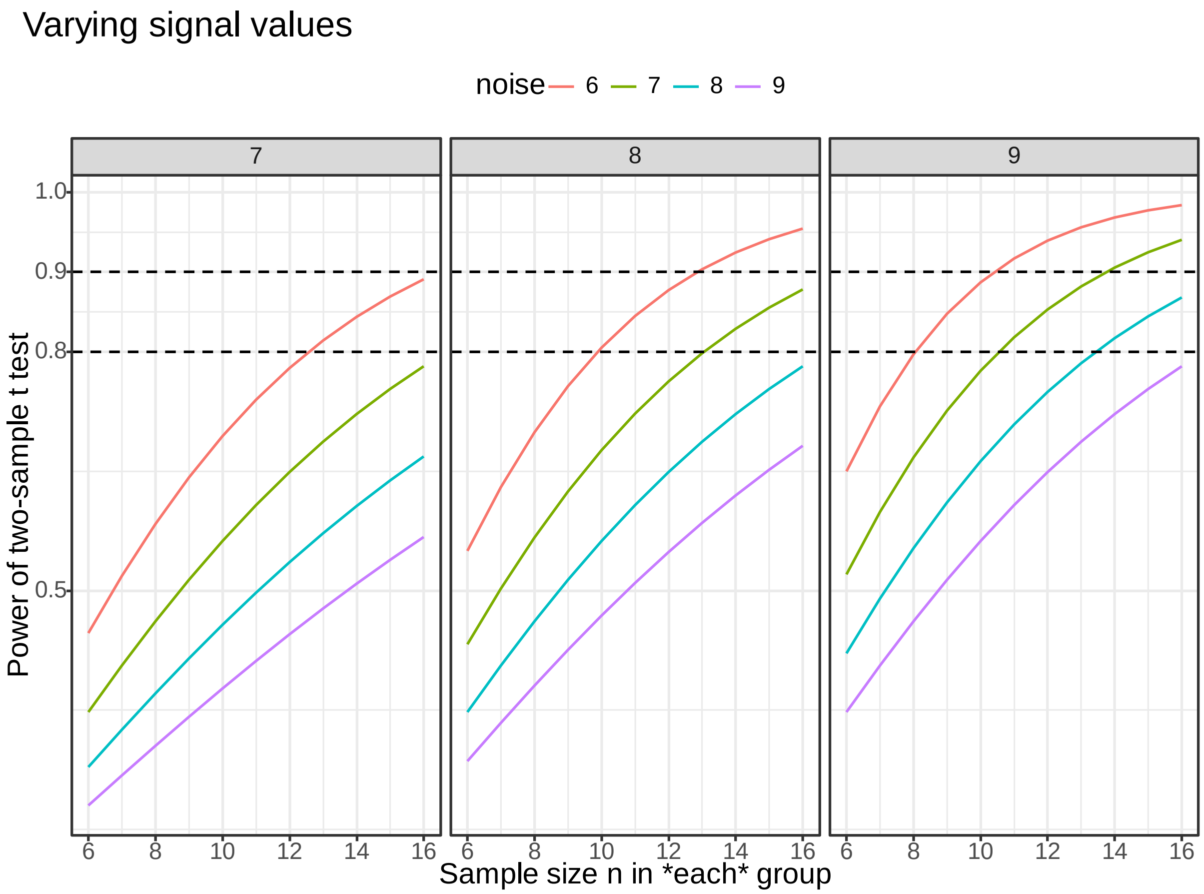
```
stats::power.t.test(delta = 8, sd = 6, sig.level = 0.05, power = 0.80,
                    type = "two.sample", alternative = "two.sided")

##
##      Two-sample t test power calculation
##
##               n = 9.889068
##           delta = 8
##              sd = 6
##       sig.level = 0.05
##           power = 0.8
##     alternative = two.sided
##
## NOTE: n is number in *each* group
```

Varying signal-to-noise ratio



$$\sqrt{n} \propto \frac{\textbf{power}}{\textbf{signal/noise}}$$

Hm, I don't know the noise…



$$\sqrt{n} \propto \frac{\text{power}}{\text{signal/noise}}$$

Sample size estimation: reality check…

- Feasibility
  - Laboratory-specific processing
  - Personnel and personnel-hours available
  - Training for the experimenters
  - Training for the animals
  - Supplier
  - Caging
  - …
- Amount of resources you are willing to spend
- Timeline and milestone
- …