

# Cronbachs alpha estimation

## Cronbach's alpha estimation with R

### Explanations of the Sections:

- **Bonett-Formula:** Provides a mathematical way to estimate the required sample size based on desired Cronbach's Alpha, test power, confidence level, and the number of items in the test.
- **presize package:** provides a quick way in R to calculate the required sample size of cronbachs alpha based on a different approach.
- **R-code:** Shows how to implement the sample size calculation using the Bonett (2002) method, as well as an alternative using the **presize** package.

### Via the Bonett-Formula

The required sample size  $N$  for Cronbach's Alpha can be calculated using the **Bonett-Formula** (Bonett 2002)

$$N = \frac{(Z_{\alpha/2} + Z_{\beta})^2 \cdot (1 - \alpha) \cdot k}{\alpha}$$

### Explanations:

- $N$  : Required sample size
- $\alpha$ : Desired Cronbach's Alpha (e.g., 0.7 or 0.8)
- $Z_{\alpha/2}$ : The critical Z-value for the confidence level (e.g., for a 95% confidence interval, the value is 1.96)
- $Z_{\beta}$ : The critical Z-value for the test power (e.g., for 80% power, the value is 0.84)
- $k$ : Number of items in the test (e.g., 10 items)

The formula calculates the minimum sample size required to achieve a desired Cronbach's Alpha with a given test power and confidence level.

## Code example

```
# Input parameters
alpha1 <- 0.8      # Expected Cronbach's Alpha
alpha0 <- 0.70     # Minimum value (null hypothesis)
k <- 23            # Number of items
alpha <- 0.05      # Significance level
power <- 0.80      # Desired power

# Z-values
z_alpha <- qnorm(1 - alpha / 2)
z_beta <- qnorm(power)

# Calculation of required sample size according to Bonett (2002)
log_term <- log((1 - alpha0) / (1 - alpha1))
numerator <- (z_alpha + z_beta)^2
denominator <- log_term^2
multiplier <- (2 * (k - 1) / k)^2

n <- ceiling(numerator / denominator * multiplier)

cat("Required sample size:", n, "\n")
```

Required sample size: 175

## via the presize - package (Haynes et al. 2021)

### code example

```
#install.packages("presize")

library(presize)
```

Warning: Paket 'presize' wurde unter R Version 4.4.3 erstellt

```
prec_cronb(k = 23, calpha = 0.8, n = NULL, conf.level = 0.95, conf.width = 0.1)
```

sample size for Cronbach's alpha

	calpha	k	n	conf.width	conf.level	lwr	upr
1	0.8	23	132	0.1	0.95	0.7452753	0.845356

### Explanations:

- $N$ : Required sample size
- *calpha*: expected Cronbach's Alpha (e.g., 0.7 or 0.8)
- *conf.level* : confidence level
- *conf.width*: precision (the full width of the confidence interval). is 0.84)
- $k$ : Number of items in the test (e.g., 10 items)

### References

- Bonett, Douglas G. 2002. "Sample Size Requirements for Testing and Estimating Coefficient Alpha." *Journal of Educational and Behavioral Statistics* 27 (4): 335–40. <https://doi.org/10.3102/10769986027004335>.
- Haynes, Alan G., Armando Lenz, Odile Stalder, and Andreas Limacher. 2021. "'Presize': An r-Package for Precision-Based Sample Size Calculation in Clinical Research" 6: 3118. <https://doi.org/10.21105/joss.03118>.