การคำนวณขนาดตัวอย่าง สำหรับการวิจัยในมนุษย์

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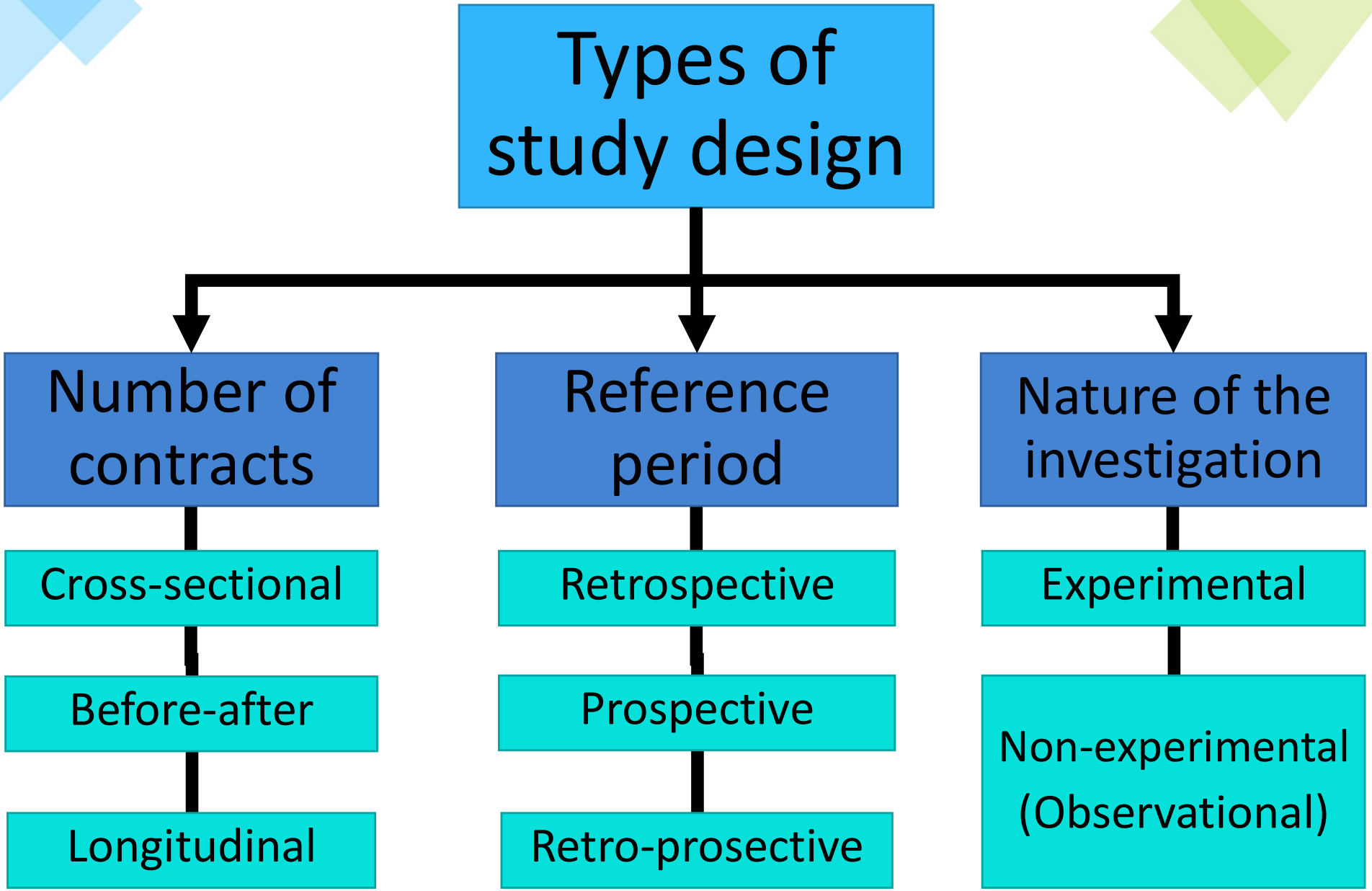
หัวข้อวันนี้

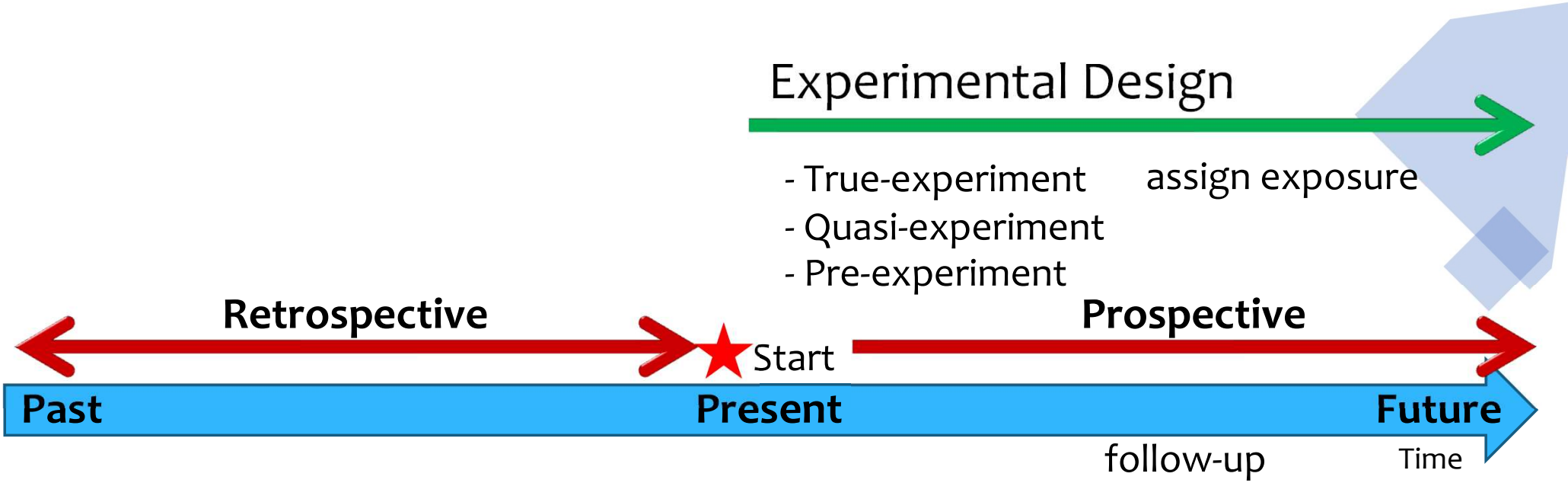
พื้นฐานของวิจัยและสถิติที่ใช้สำหรับการคำนวณขนาดตัวอย่าง

หลักการพิจารณาเลือกวิธีการคำนวณขนาดตัวอย่างที่เหมาะสมกับรูปแบบการวิจัย

การใช้โปรแกรมหรือแอปพลิเคชั่นสำเร็จรูปในการคำนวณขนาดตัวอย่าง

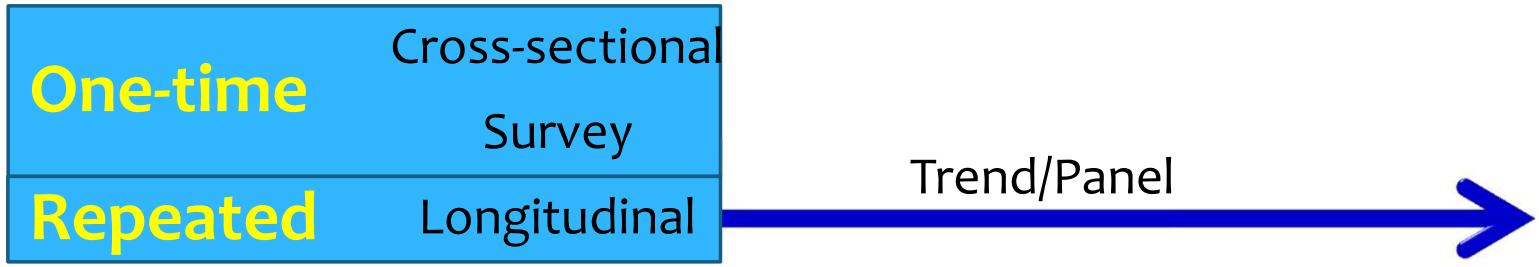
พื้นฐานของวิจัยและสถิติที่ใช้สำหรับการคำนวณขนาดตัวอย่าง


Types of study design
Number of contracts
Reference period
Nature of the investigation
Cross-sectional
Before-after
Longitudinal
Retrospective
Prospective
Retro-prosective
Experimental
Non-experimental (Observational)

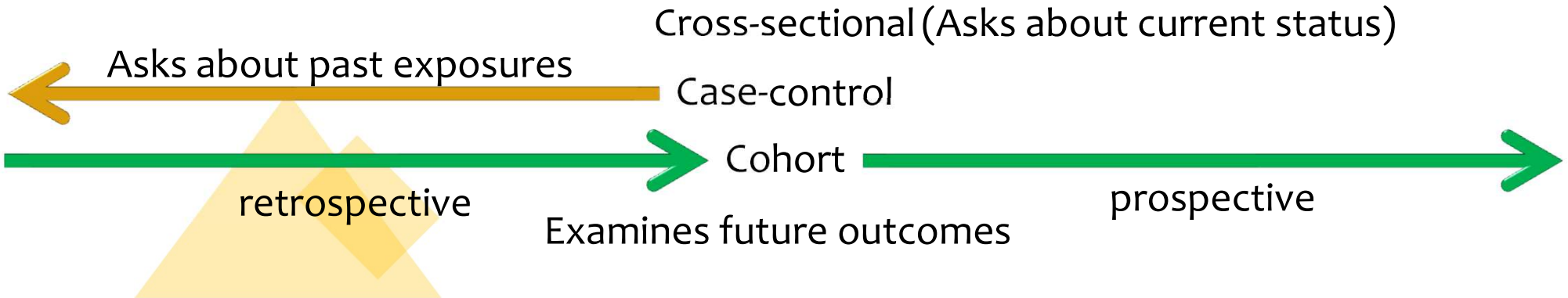


Observational Design (Descriptive)

- Case-report
- Case-series



Analytical Design (Cause-and-Effect)



Research Objective

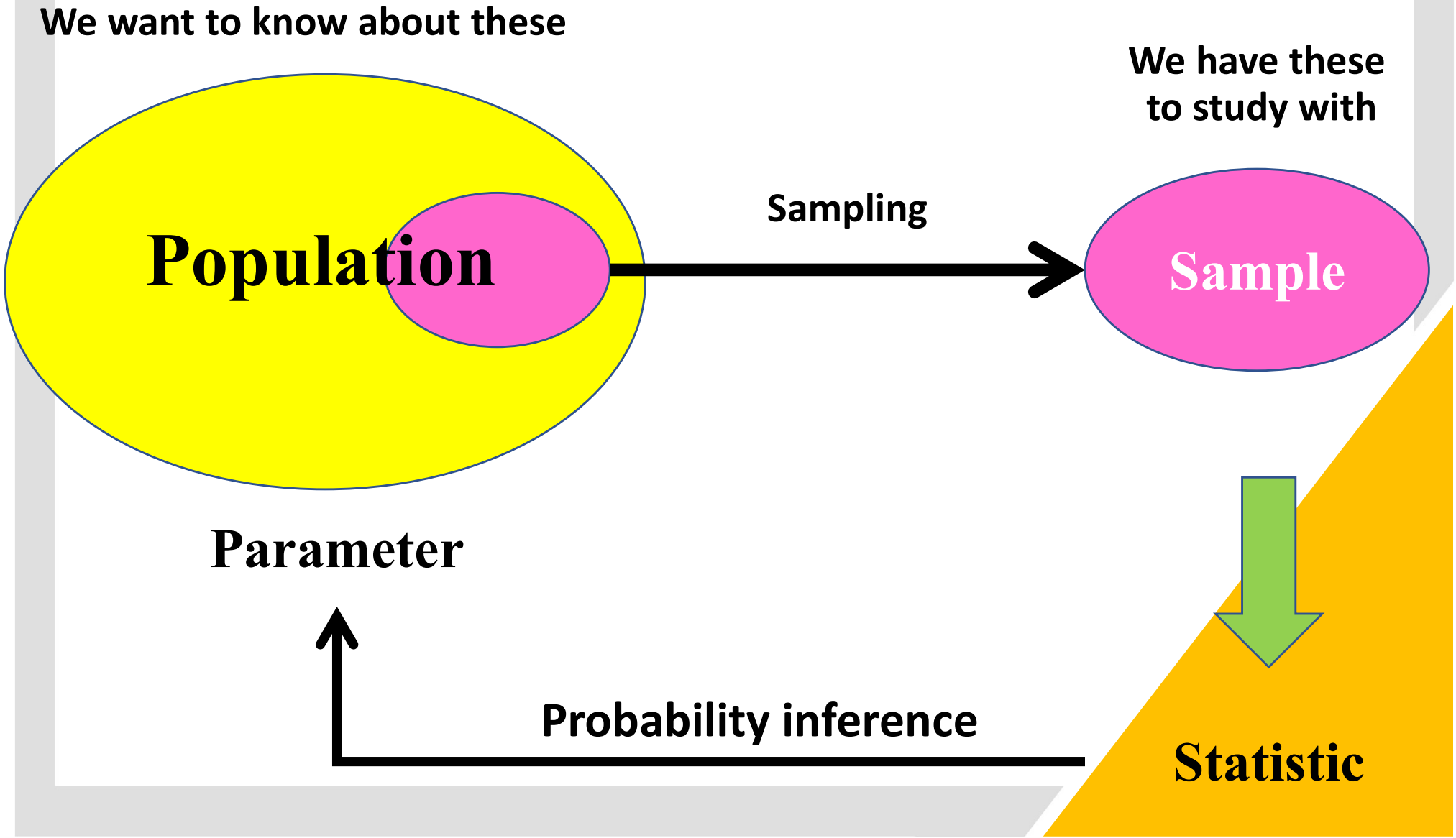
Descriptive

- Design
  - Cross sectional study
  - Sample survey
- Statistical analysis
  - Estimation (no comparison)

Comparison/Association/ Modelling

- Design
  - Analytic study
  - Experimental study
- Statistical analysis
  - Hypothesis testing (comparison)

What is Population and Sample?



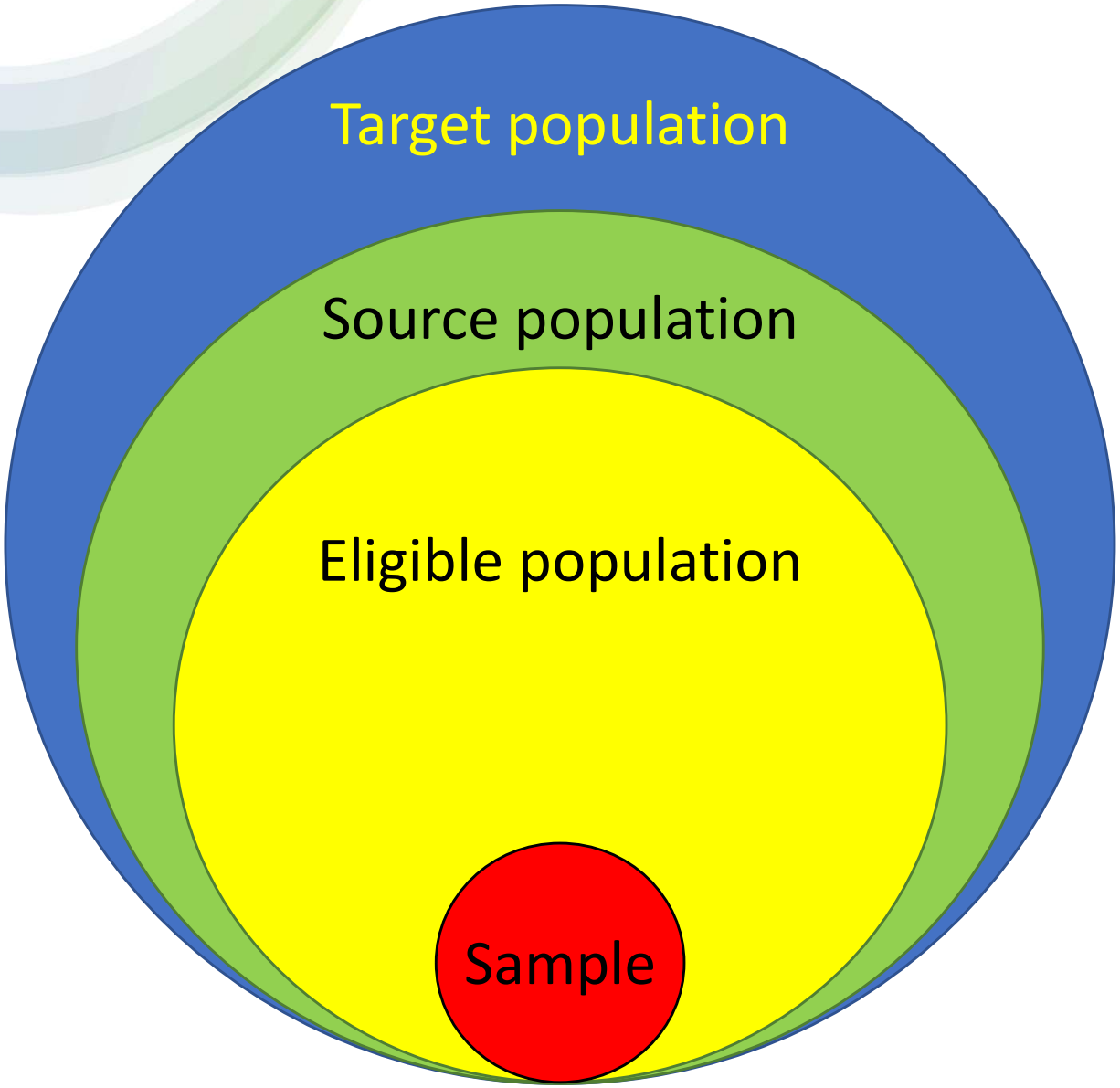
Population

- General term: Universe set
- Statistical term:
  All members of a defined group that we are studying or collecting information

Type:

- **Finite population**
  - **Small**
  - **Large**
- **Infinite population**

Population



Sampling frame (N)

Sample

- Subset of population
- To represent the population well:
  - randomly collected
  - adequately size
- subject => smallest sampling unit

Type of variable (I)

- **Independent variable/ Factor/ Treatment/ Predictive**
- **Dependent variable/ Outcome**

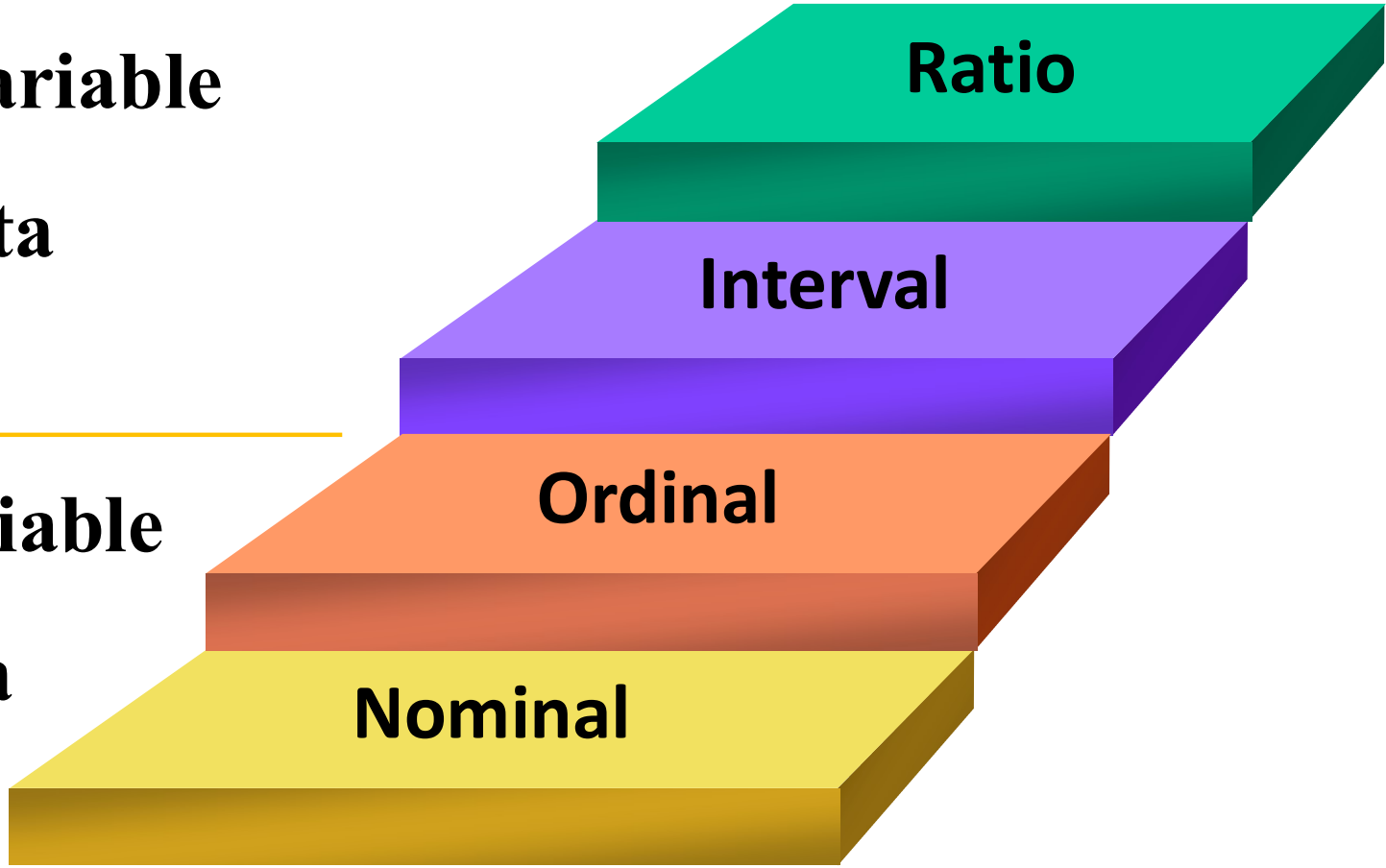
Type of variable (II)

- Quantitative variable
  - Discrete variable
  - Continuous variable
- Qualitative variable
  - Binary/dichotomous variable
  - Polychotomous variable

Measurement levels

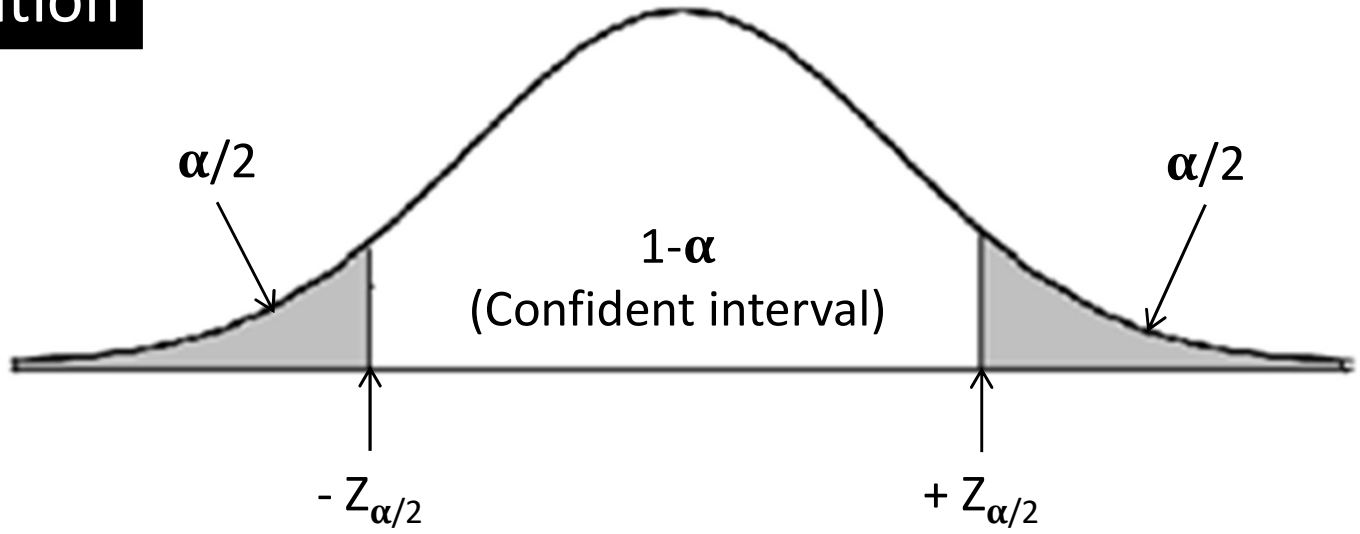
- **Quantitative variable**
- **Continuous data**

- **Qualitative variable**
- **Categories data**

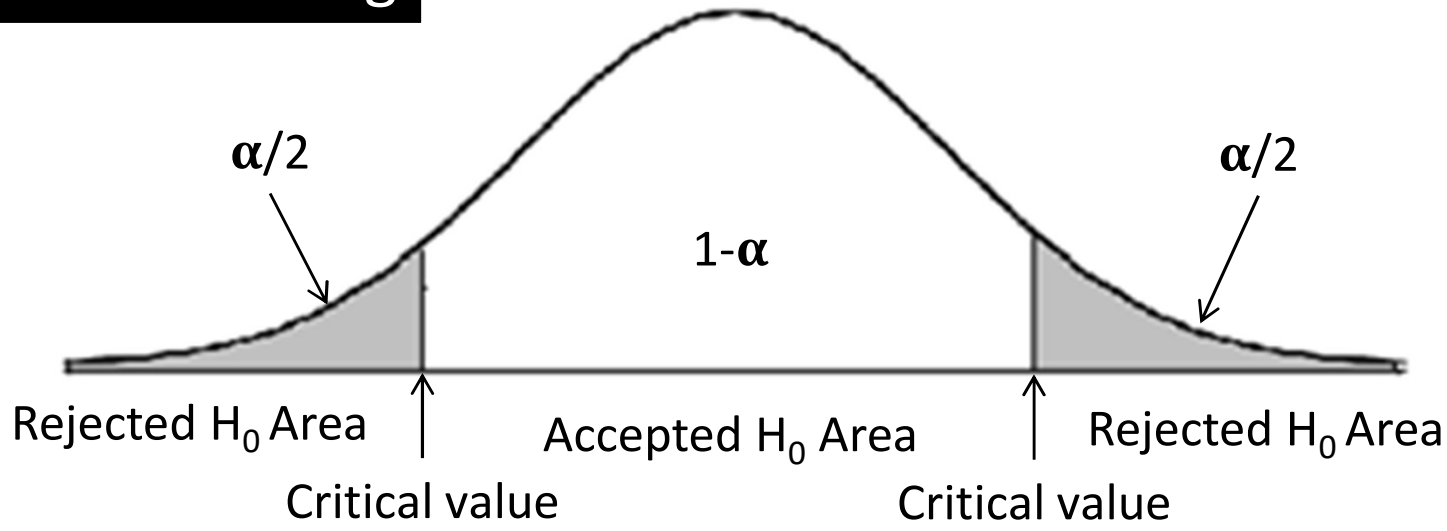


Inferential Statistics

Estimation



Hypothesis testing

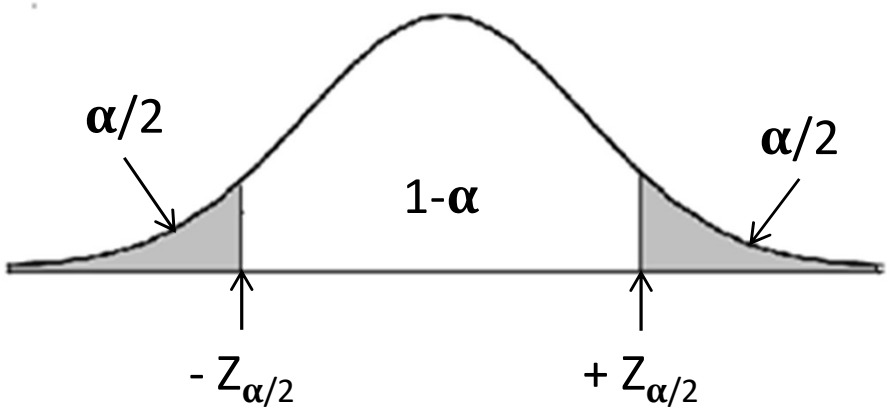


Statistical Hypothesis

- Two-tail (two-side)

$H_0: \mu = \mu_0$

$H_A: \mu \neq \mu_0$



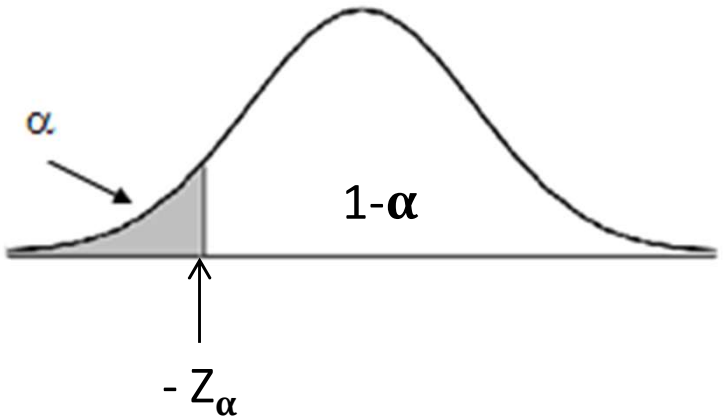
- One-tail (one-side)

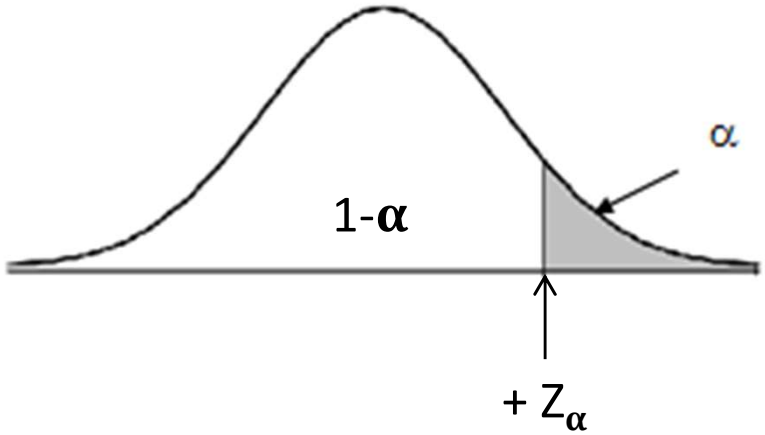
$H_0: \mu \geq \mu_0$

$H_A: \mu < \mu_0$

$H_0: \mu \leq \mu_0$

$H_A: \mu > \mu_0$

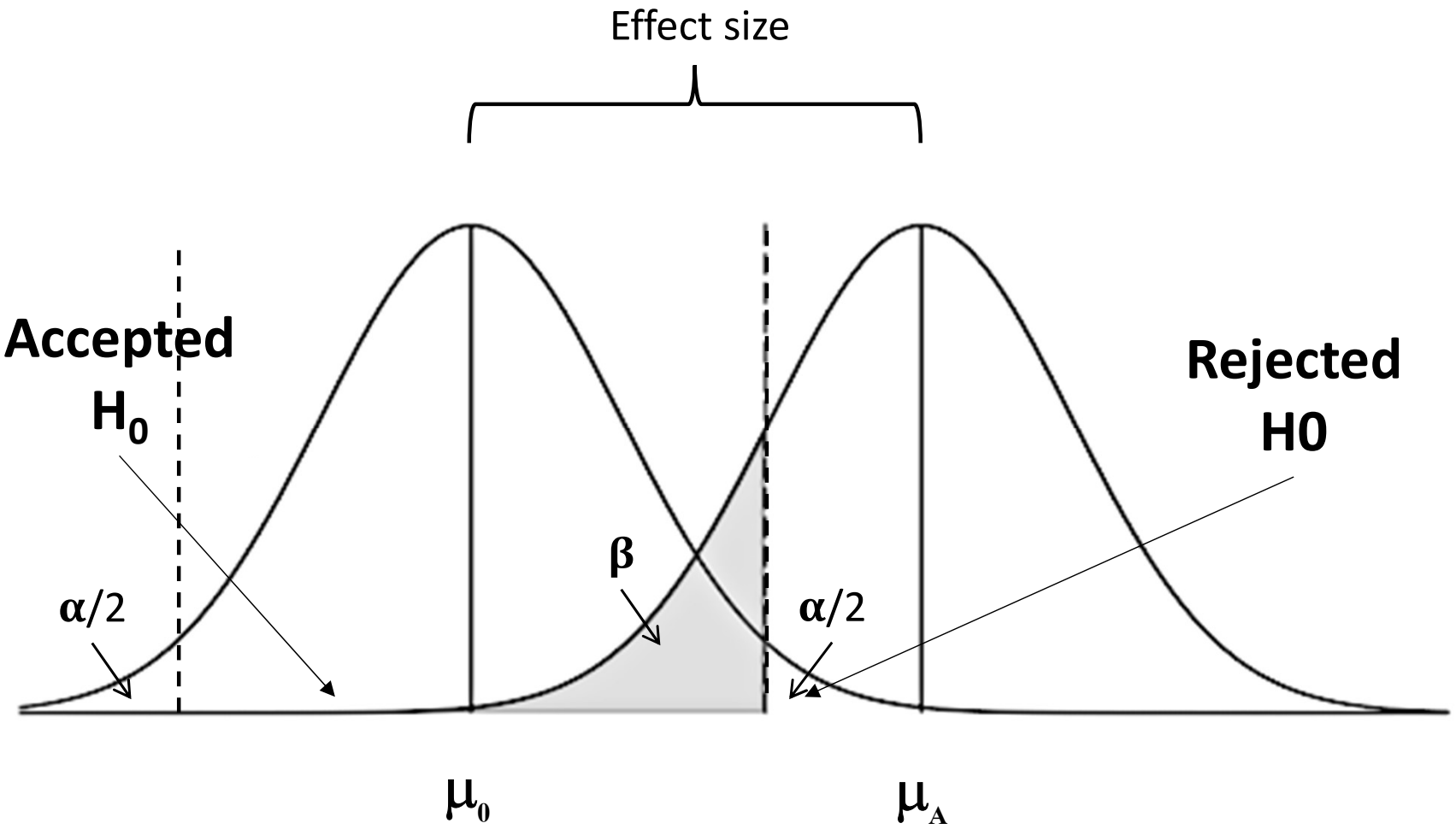




Significance and power

		Truth (real world)	
		H_0 true No difference	H_0 false Difference
Decision (statistical analysis)	Accepted H_0	Correct decision (CI) = 1- α	Type II error = β
	Reject H_0	Type I error level (α =>significance)	Correct decision (power) = 1-β

Significance and power



Z-value by significant level (α)

α	$Z_{\alpha/2}$	Z_{α}
0.10	**1.645**	**1.282**
0.05	**1.96**	**1.645**
0.01	**2.576**	**2.326**

Z-value by Power of test (1-β)

Power	β	Z_β
80%	**0.20**	**0.842**
90%	**0.10**	**1.282**
95%	**0.05**	**1.645**

How to select sample size equation

Appropriated sample size

- Primary objective
  - for estimation
  - for hypothesis testing: comparison, association
- Primary outcome/parameter

  => Total, Average, Proportion, Ratio
- Research design
- Sampling technique

Sample size equation (general)

Representative sample in infinite/large populations (Cochran, 1963)

$$n_0 = \frac{Z^2_{\alpha/2}(\text{VARIANCE})}{d^2}$$

When n_0 : number of sample

and $d = e$

d : precision of estimation

e : acceptable sampling error

Sample size equation (general)

Finite population correction

$$n = \frac{n_0}{1 + (\frac{n_0}{N})}$$

When N : number of population

n_0 : initial sample size

n : adjusted sample size

Sample size equation for estimation

Mean estimation

- Infinite population

$$n_0 = \frac{Z^2_{\alpha/2}\sigma^2}{d^2}$$

- Finite population

$$n = \frac{Z^2_{\alpha/2}N\sigma^2}{Z^2_{\alpha/2}\sigma^2 + (N-1)d^2}$$

$$n = \frac{n_0}{1+(\frac{n_0}{N})}$$

Sample size equation for estimation

When

- n = number of sample
- N = number of population
- σ = standard deviation of population parameter (estimated by s.d.)
- d = precision of estimation
  = $|\bar{x}-\mu|$
  = $\varepsilon*\mu$ when ε = relative precision of estimation
  = $|\bar{x}-\mu|/\mu$

Example

ในการศึกษาน้ำหนักของทารกแรกคลอดที่เข้าโปรแกรมรับฝากครรภ์ของโรงพยาบาลแห่งหนึ่ง ซึ่งมีสถิติน้ำหนักของทารกแรกคลอดทั้งประเทศ มีค่าเฉลี่ย 2800 กรัม s.d. 500 กรัม หากต้องการประมาณค่าเฉลี่ยของน้ำหนักทารกแรกคลอดของโรงพยาบาลแห่งนี้ จะต้องเลือกตัวอย่างมาจำนวนเท่าใด

- ตัวแปรที่ศึกษา => น้ำหนักทารกแรกคลอด => เชิงปริมาณ
- วัตถุประสงค์ => ประมาณค่าเฉลี่ย
- สูตรคำนวณขนาดตัวอย่าง => mean estimation
- ผู้ศึกษากำหนด ช่วงความเชื่อมั่น 95% (α=0.05)
  ความคลาดเคลื่อนสัมพัทธ์ไม่เกิน 5% (ε=0.05)
- เมื่อกำหนด α = 0.05 => $Z_{\alpha/2}$ = 1.96
- d = mean*ε = 2800*0.05 = 140
- σ = s.d. = 500
- แทนค่า

$$n_0 = \frac{Z^2_{\alpha/2}\sigma^2}{d^2} = \frac{1.96^2 \times 500^2}{140^2} = 49$$

ดังนั้นจะต้องสุ่มทารกแรกคลอดมาจำนวน 49 คน

Sample size equation for estimation

Proportion estimation

- Infinite population

$$n_0 = \frac{Z^2_{\alpha/2}\pi(1-\pi)}{d^2}$$

- Finite population

$$n = \frac{n_0}{1+(\frac{n_0}{N})}$$

$$n = \frac{Z^2_{\alpha/2}N\pi(1-\pi)}{Z^2_{\alpha/2}\pi(1-\pi)+(N-1)d^2}$$

Sample size equation for estimation

When

- n = number of sample
- N = number of population
- π = proportion of population parameter
- d = precision of estimation
  = $|p - \pi|$

Example

ในการศึกษาภาวะกระดูกพรุนในประชากรวัยกลางคนของโรงพยาบาลแห่งหนึ่ง ซึ่งจากการศึกษาของ Lekamwasam (2009) ที่พบภาวะกระดูกพรุนในอาสาสมัคร 5.8% (p=0.058) ดังนั้นจะต้องเลือกตัวอย่างมาจำนวนเท่าใด

- ตัวแปรที่ศึกษา => ภาวะกระดูกพรุน => เชิงคุณภาพ (สัดส่วนของภาวะกระดูกพรุน)
- วัตถุประสงค์ => ประมาณค่าสัดส่วน
- สูตรคำนวณขนาดตัวอย่าง => proportion estimation
- ผู้ศึกษากำหนด ช่วงความเชื่อมั่น 95% (α=0.05)
  ความคลาดเคลื่อนที่ยอมให้เกิดขึ้นได้ไม่เกิน 5% (e=0.05)
- เมื่อกำหนด α = 0.05 => $Z_{\alpha/2}$ = 1.96
- แทนค่า

$$n_0 = \frac{Z^2_{\alpha/2}\pi(1-\pi)}{d^2} = \frac{1.96^2 \times 0.058(1-0.058)}{0.05^2} = 83.96$$

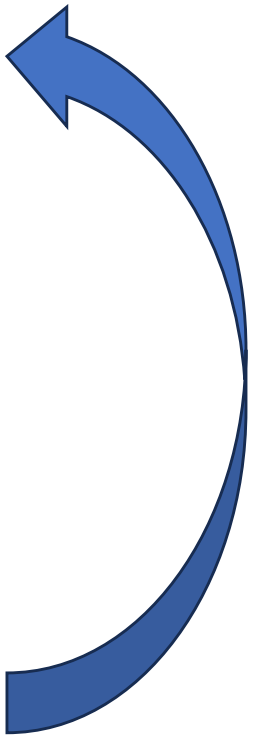
ดังนั้นจะต้องสุ่มผู้ชายวัยกลางคนมาจำนวน 84 คน

Sample size equation for estimation

A simplified formula for proportions

- Taro Yamane (1967)

$$n = \frac{N}{1 + Ne^2}$$



$$n = \frac{Z^2_{\alpha/2} N \pi (1-\pi)}{Z^2_{\alpha/2} \pi (1-\pi) + (N-1)d^2}$$

Define: $Z^2_{\alpha/2} = 2$

$\pi = 0.5$

Yamane, T. (1967). Statistics, An Introductory Analysis, 2nd Ed., New York: Harper and Row.

Sample size equation for estimation

A simplified formula for proportions

- Krejcie & Morgan (1970)

$$n = \frac{\chi^2_\alpha N \pi(1-\pi)}{\chi^2_\alpha \pi(1-\pi) + (N-1)d^2}$$

Define: $\chi^2_\alpha = \chi^2_{.05,1} = 3.841$

$\pi = 0.5$

$d = 0.05$

Krejcie, RV, & DW Morgan. (1970). Determining Sample Size for Research Activities.*Educational and Psychological Measurement.*

Sample size equation for hypothesis testing

mean difference of one group

Hypothesis

$H_0 : \mu = \mu_0$ $\quad$ $H_0 : \mu \leq \mu_0$ หรือ $H_0 : \mu \geq \mu_0$

$H_A : \mu \neq \mu_0$ $\quad$ $H_A : \mu > \mu_0$ $\quad$ $H_A : \mu < \mu_0$

$$n = \frac{\left(Z_{\alpha/2} + Z_{\beta}\right)^2 \sigma^2}{(\mu - \mu_0)^2}$$

$$n = \frac{\left(Z_{\alpha} + Z_{\beta}\right)^2 \sigma^2}{(\mu - \mu_0)^2}$$

Sample size equation for hypothesis testing

mean difference between 2 independent groups

Hypothesis

$H_0 : \mu_1 = \mu_2$

$H_A : \mu_1 \neq \mu_2$

General

$$n_{\text{per group}} = \frac{(Z_{\alpha/2} + Z_{\beta})^2 (\sigma_1^2 + \sigma_2^2)}{(\mu_1 - \mu_2)^2}$$

Define: $\sigma_1^2 = \sigma_2^2 = \sigma^2$

$$n_{\text{per group}} = \frac{(Z_{\alpha/2} + Z_{\beta})^2 2\sigma^2}{(\mu_1 - \mu_2)^2}$$

Define: $n = n_1 + n_2$

$$n = \frac{(Z_{\alpha/2} + Z_{\beta})^2 4\sigma^2}{(\mu_1 - \mu_2)^2}$$

Sample size equation for hypothesis testing

mean difference between 2 dependent groups

Hypothesis

$H_0 : \mu_D = 0$

$H_A : \mu_D \neq 0$

$$n = \frac{\left(Z_{\alpha/2} + Z_{\beta}\right)^2 \sigma_D^2}{\mu_D^2}$$

Sample size equation for hypothesis testing

proportion difference between 2 groups

Hypothesis

$H_0 : \pi_1 = \pi_2$

$H_A : \pi_1 \neq \pi_2$

กรณี $n_1 : n_2 = 1 : 1$

$$n_{\text{per group}} = \frac{\left(Z_{\alpha/2}\sqrt{2\bar{\pi}(1-\bar{\pi})} + Z_{\beta}\sqrt{\pi_1(1-\pi_1)+\pi_2(1-\pi_2)}\right)^2}{(\pi_1-\pi_2)^2}$$

กรณี $n_1 : n_2 = 1 : k$

$$n_{\text{per group}} = \frac{\left(Z_{\alpha/2}\sqrt{(k+1)\bar{\pi}(1-\bar{\pi})} + Z_{\beta}\sqrt{k\pi_1(1-\pi_1)+\pi_2(1-\pi_2)}\right)^2}{(\pi_1-\pi_2)^2}$$

Sample size equation for hypothesis testing

correlation between 2 continuous variables

Hypothesis

$H_0 : \rho = o$

$H_A : \rho \neq 0$

$$n = \frac{(Z_{\alpha/2} + Z_{\beta})^2}{C(r)} + 3$$

$$C(r) = \frac{1}{2} \ln\left(\frac{1+r}{1-r}\right)$$

Sample size equation for hypothesis testing

Effect size

Cohen's d

$$d = \frac{\bar{x}_1 - \bar{x}_2}{s}$$

$$s_{pooled} = \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{(n_1 + n_2 - 2)}}$$

Effect size

d = 0.02 : small

d = 0.05 : medium

d = 0.80 : large

Cohen, J. (1988). Statistical Power Analysis for the Behavioral Sciences. Routledge.

Sample size equation for hypothesis testing

Effect size (Cohen's d)

one group difference

$$n = \frac{\left(Z_{\alpha/2} + Z_{\beta}\right)^2}{\delta^2}$$ when δ : effect size (d)

two independent group difference

$$n = \frac{2\left(Z_{\alpha/2} + Z_{\beta}\right)^2}{\delta^2}$$

Sample size equation for Regression

Linear regression

$$n = \left[\frac{(Z_{\alpha/2} + Z_{\beta})\sigma}{\lambda_1 \sigma_x}\right]^2$$

when $\sigma = \sqrt{\sigma_y^2 - \lambda_1^2 \sigma_x^2}$

$$\rho = \frac{\sigma_x \lambda_1}{\sigma_y}$$

$\boldsymbol{\lambda}$: beta cofficience

$$n_{adj} = \frac{n}{(1 - R^2)}$$

Dupont, W.D. and Plummer, W.D. Power and Sample Size Calculations for Studies Involving Linear Regression. New York, 1998. Print.

Sample size equation for Regression

Logistic regression

$$n = \frac{4\pi(1-P)(Z_{\alpha/2} + Z_{\beta})^2}{(\pi_1 - \pi_2)^2}$$

when using OR

$$\pi_2 = \frac{\mathrm{OR} \times \pi_1}{(1-\pi_1) + \mathrm{OR} \times \pi_1}$$

$$n_{adj} = \frac{n}{(1-R^2)}$$

when R^2 : Psudo R^2

Hsieh FY, Bloch DA, Larsen MD. (1998). A simple method of sample size calculation for linear and logistic regression. Statistics in Medicine. 17(14): 1623-34.

Sample size adjustment

- Fixed percentage

$$n_{adj.} = n \times \left(1 + \frac{\%}{100}\right)$$

- Dropout rate

$$n_{adj.} = n \div \left(1 - \frac{\%dropout}{100}\right)$$

- **Green's rule of thumb**
  for regression

$$n = 50 + 8 \times \#\text{cofficients}$$

Parameter in equation

Consider from:

- 1st outcome
- important variable
- higher variance

Find parameter from:

- Previous research
- Database register
- Pilot study

16:02 Tue 22 Nov 84%

Hand exercise for women with rheumatoid arthritis and decreased hand function: an exploratory randomized controlled trial

https://www.ncbi.nlm.nih.gov

PMC Alt PDF

Hand exercise for women with rheumatoid arthritis and decreased hand function: an exploratory randomized controlled trial

Arthritis Res Ther. 2019; 21: 158.

joint protection, assistive devices, and alternative ways of performing AD. The hand-exercise program addressed range of motion and muscle strength.

Primary outcome was change in observed ADL motor ability measured by the Assessment of Motor and Process Skills (AMPS). Baseline measures were repeated after 8 weeks.

Results

Improvements in ADL motor ability in $CIP_{EXERCISE}$ (mean change = 0.24 logits; 95% CI = 0.09 to 0.39) and $CIP_{CONTROL}$ (mean change =0.20 logits; 95% CI = 0.05 to 0.35) were statistically significant, with no differences between groups (mean difference = 0.04 logits; 95% CI = − 0.16 to 0.25). Thirteen (46.4%) participants in the $CIP_{EXERCISE}$ and 12 (44.4%) in the $CIP_{CONTROL}$ obtained clinically relevant improvements (≥ 0.30 logits) in ADL motor ability; this group difference was not significant ($z = 0.15$; $p = 0.88$).

Previous Page

รูปแบบการศึกษา => one-group Experiment pre-post test

การคำนวณ sample size

$$n = \frac{(Z_{\alpha/2} + Z_{\beta})^2 \sigma_d^2}{\mu_d^2}$$

n = 27 คน

μ_d = pre-post

$\bar{d}$

ค่าเฉลี่ย $\sigma_d = \left(\frac{U_L - \bar{d}}{t_{\alpha/2, df}}\right)\sqrt{n}$

$= \left(\frac{0.39 - 0.24}{2.055}\right)\sqrt{27}$

$= 0.379$

$\alpha = 0.05$

$\beta = 0.20$

$t_{0.025, 26} = 2.055$

ที่ 95% $\alpha = 0.05 \Rightarrow Z_{\alpha/2} = 1.96$

$\beta = 0.20 \Rightarrow Z_{\beta} = 0.84$

$$n = \frac{(1.96 + 0.84)^2 (0.379)^2}{(0.24)^2} = 22 \text{ คน}$$

หาก $\beta = 0.10 \Rightarrow Z_{\beta} = 1.24$

$$n = \frac{(1.96 + 1.24)^2 (0.397)^2}{(0.24)^2} = 29 \text{ คน}$$

การเลือกสูตรคำนวณขนาดตัวอย่าง ระดับความเชื่อมั่นจาก กิตติประสงค์การวิจัย

① เพื่อประมาณค่า → design = descriptive study
มีการเก็บรวบรวมข้อมูล / ทางสถิติ

สูตร $n = \frac{Z^2_{\alpha/2}\sigma^2}{d^2}$

* ใช้สูตรนี้เมื่อมี continuous outcome

ถ้ามีการเปรียบเทียบกับประชากร

$n = \frac{N Z^2_{\alpha/2}\sigma^2}{(N-1)d^2 + Z^2_{\alpha/2}\sigma^2}$

② เพื่อทดสอบสมมติฐาน
↳ design = analytic study
⇓
experimental study
เพื่อเปรียบเทียบ ⇒ ตัวแปรอิสระ, ตาม

สูตร $n = \frac{(Z_{\alpha/2} + Z_\beta)^2 2\sigma^2}{(\mu_1 - \mu_2)^2}$

ซึ่งไม่มีการเปรียบเทียบกับประชากร

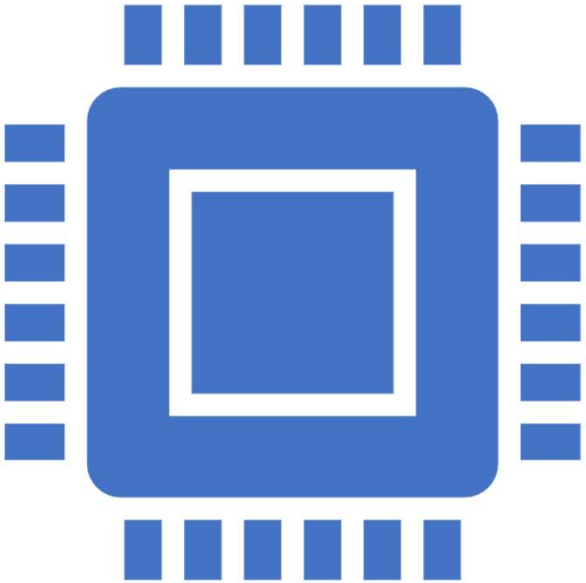
* $Z_{\alpha/2}$ ⇒ α = Type I error
$1-\alpha$ = confidence interval

Z_β ⇒ β = Type II error
$1-\beta$ = power of test

ตัวอย่าง: เรื่อง
มีทั้ง $Z_{\alpha/2}$ และ Z_β
ถ้ามีการเปรียบเทียบ/ทดสอบสมมติฐาน
ถ้าไม่มีการใช้ประชากร (N)
เข้ามาเกี่ยวข้อง

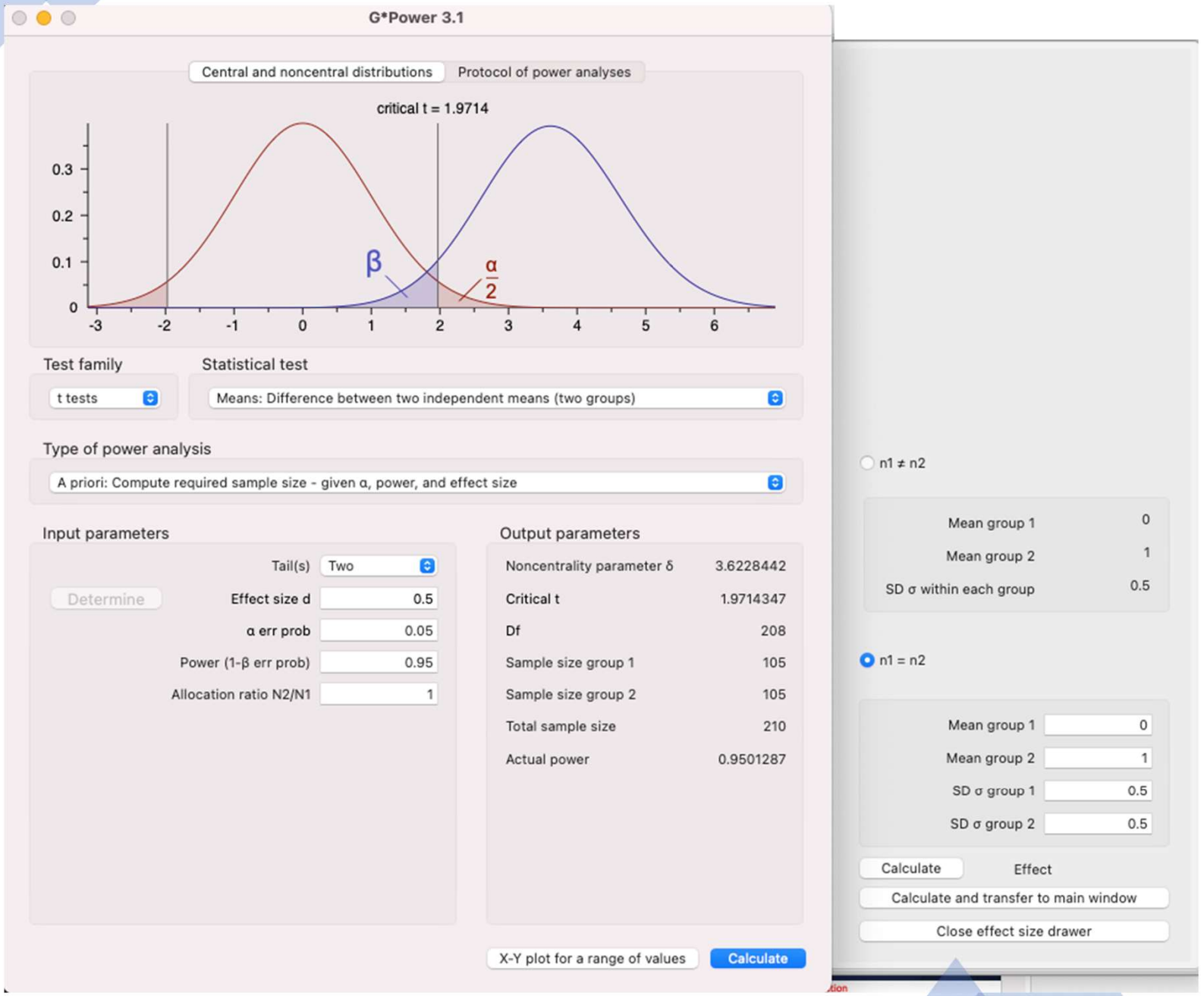
Sample size

A sample size estimation was conducted as described by Hulley et al. (2013) [28]. A power calculation was conducted based on a critical α-value of 0.05 and a 1-β of 0.2. To reach a power level of 80% 30 participants were required.

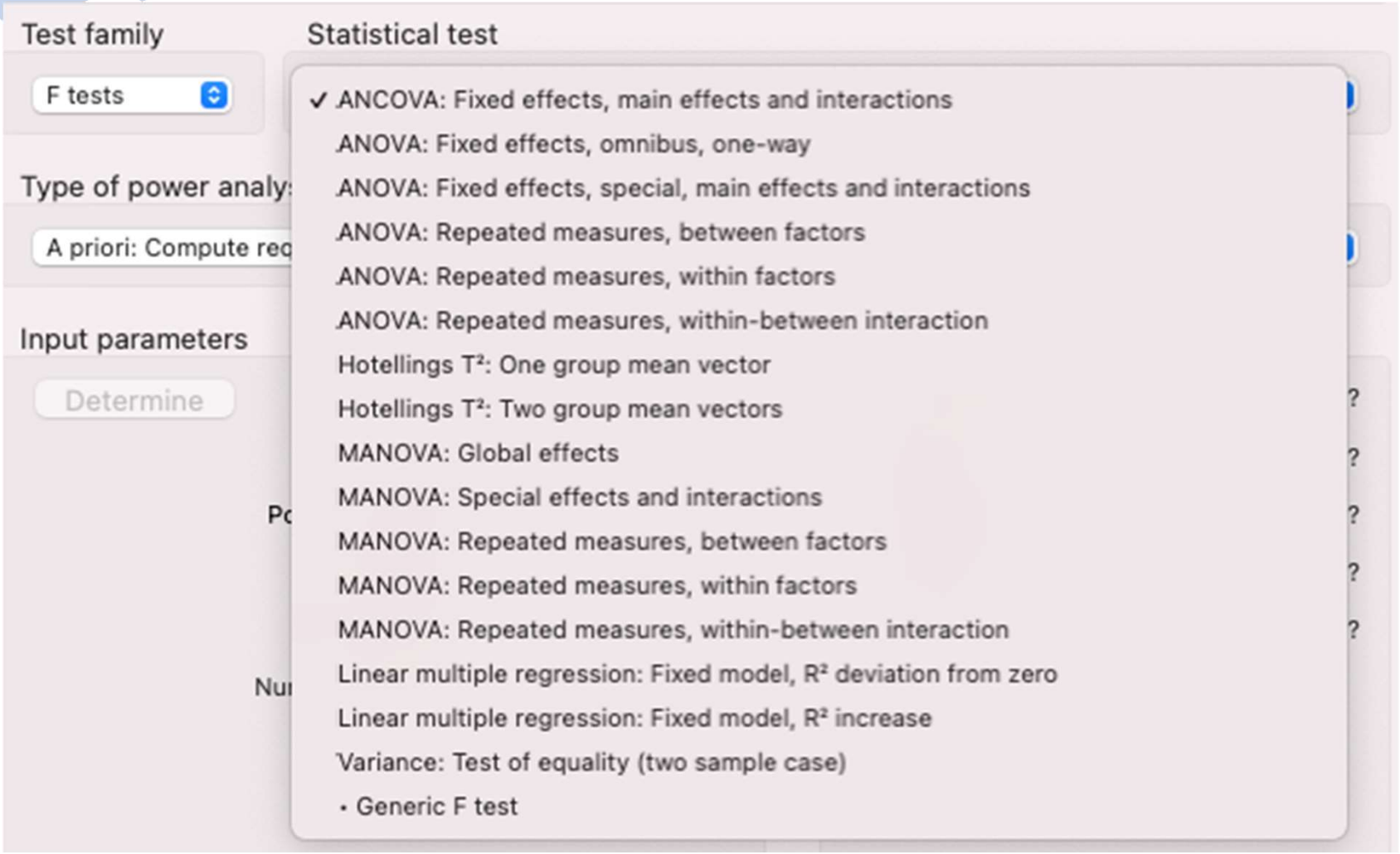


Software & Application

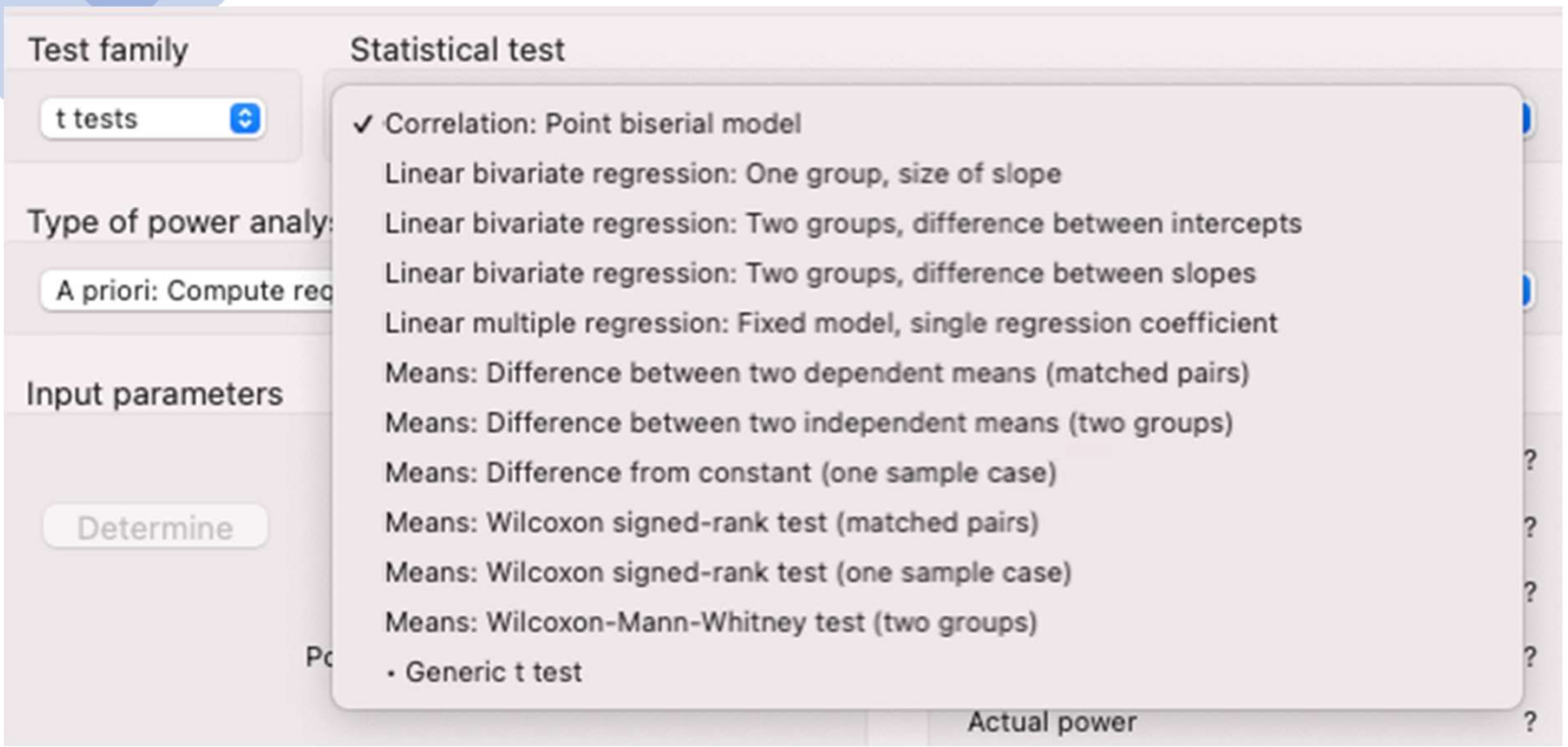
G*Power

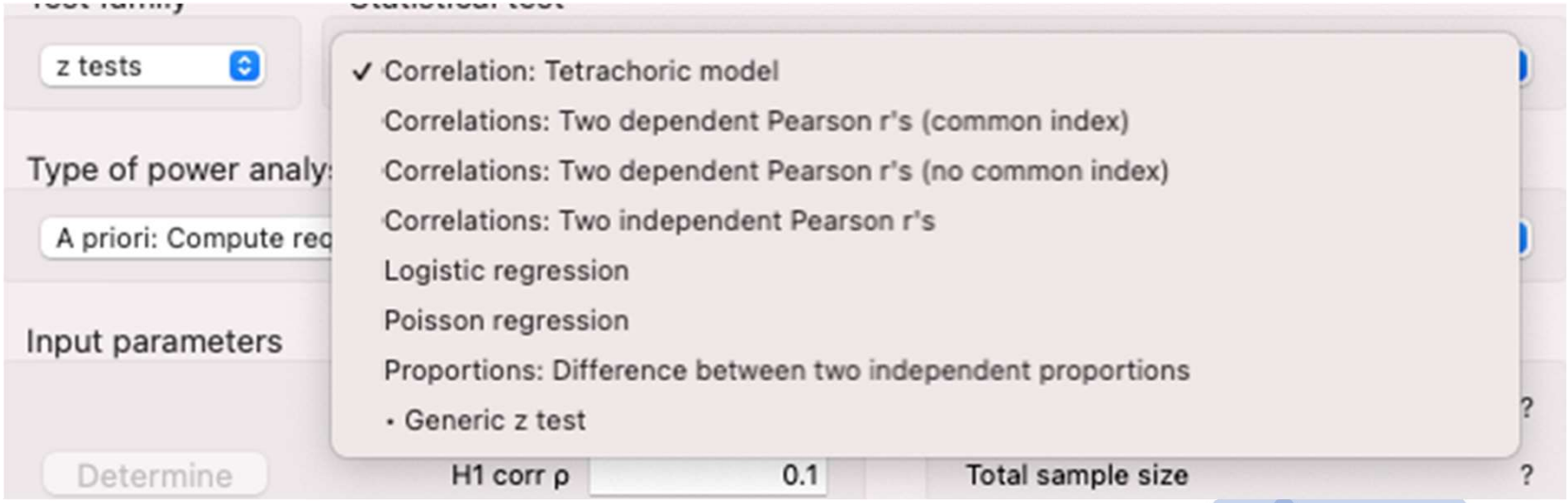

G*Power 3.1
Central and noncentral distributions
Protocol of power analyses
critical t = 1.9714
0.3
0.2
0.1
0
-3
-2
-1
0
1
2
3
4
5
6
β
α/2
Test family
t tests
Statistical test
Means: Difference between two independent means (two groups)
Type of power analysis
A priori: Compute required sample size - given α, power, and effect size
Input parameters
Tail(s) Two
Determine
Effect size d 0.5
α err prob 0.05
Power (1-β err prob) 0.95
Allocation ratio N2/N1 1
Output parameters
Noncentrality parameter δ 3.6228442
Critical t 1.9714347
Df 208
Sample size group 1 105
Sample size group 2 105
Total sample size 210
Actual power 0.9501287
X-Y plot for a range of values
Calculate
n1 ≠ n2
Mean group 1 0
Mean group 2 1
SD σ within each group 0.5
n1 = n2
Mean group 1 0
Mean group 2 1
SD σ group 1 0.5
SD σ group 2 0.5
Calculate
Effect
Calculate and transfer to main window
Close effect size drawer

G*Power


Test family
F tests
Statistical test
Type of power analy
A priori: Compute req
Input parameters
Determine
Po
Nu
✓ ANCOVA: Fixed effects, main effects and interactions
ANOVA: Fixed effects, omnibus, one-way
ANOVA: Fixed effects, special, main effects and interactions
ANOVA: Repeated measures, between factors
ANOVA: Repeated measures, within factors
ANOVA: Repeated measures, within-between interaction
Hotellings T²: One group mean vector
Hotellings T²: Two group mean vectors
MANOVA: Global effects
MANOVA: Special effects and interactions
MANOVA: Repeated measures, between factors
MANOVA: Repeated measures, within factors
MANOVA: Repeated measures, within-between interaction
Linear multiple regression: Fixed model, R² deviation from zero
Linear multiple regression: Fixed model, R² increase
Variance: Test of equality (two sample case)
• Generic F test

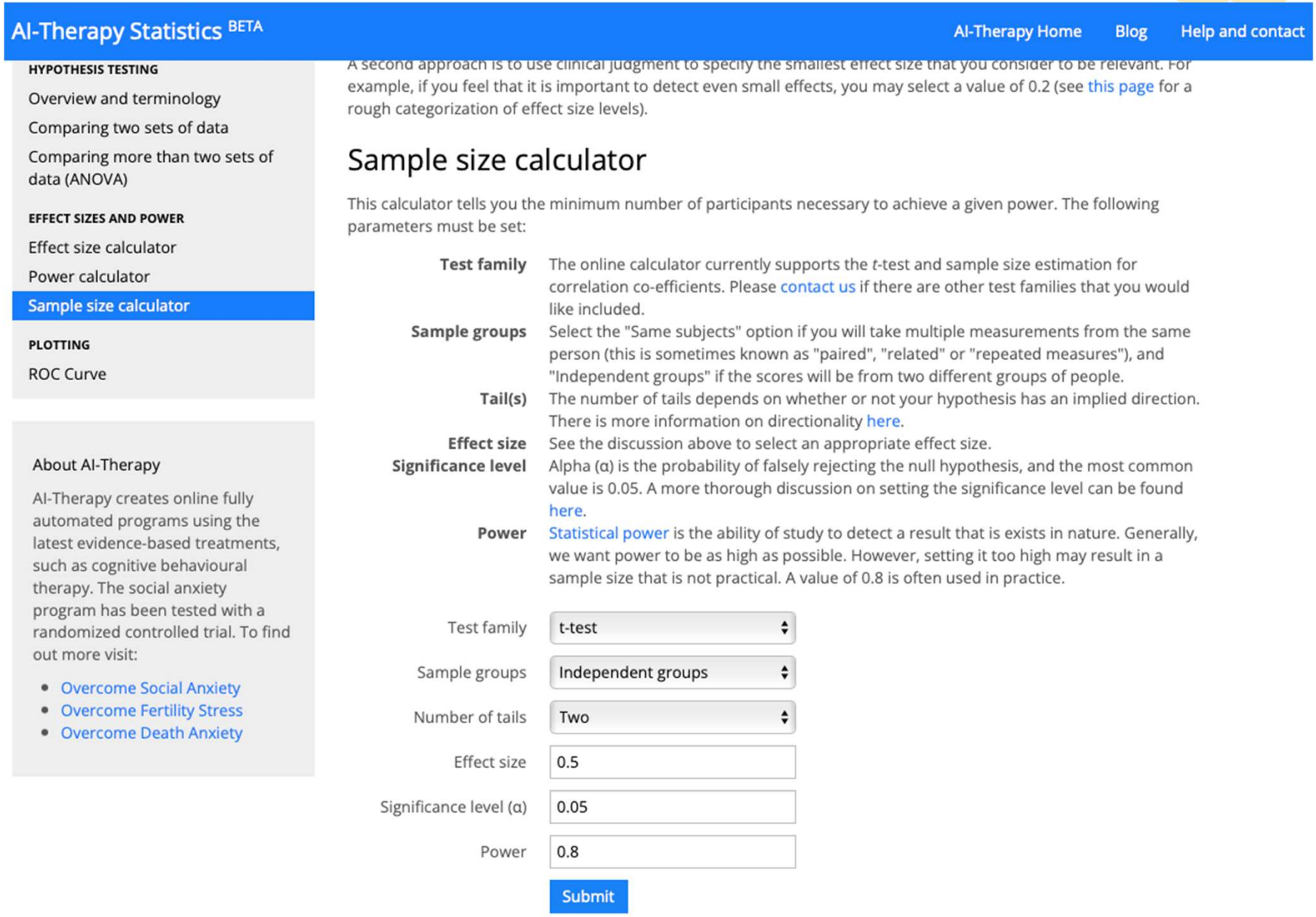
G*Power


Test family
Statistical test
t tests
Correlation: Point biserial model
Linear bivariate regression: One group, size of slope
Linear bivariate regression: Two groups, difference between intercepts
Linear bivariate regression: Two groups, difference between slopes
Linear multiple regression: Fixed model, single regression coefficient
Means: Difference between two dependent means (matched pairs)
Means: Difference between two independent means (two groups)
Means: Difference from constant (one sample case)
Means: Wilcoxon signed-rank test (matched pairs)
Means: Wilcoxon signed-rank test (one sample case)
Means: Wilcoxon-Mann-Whitney test (two groups)
Generic t test
Type of power analy
A priori: Compute req
Input parameters
Determine
Actual power


z tests
Correlation: Tetrachoric model
Correlations: Two dependent Pearson r's (common index)
Correlations: Two dependent Pearson r's (no common index)
Correlations: Two independent Pearson r's
Logistic regression
Poisson regression
Proportions: Difference between two independent proportions
Generic z test
Type of power analy
A priori: Compute req
Input parameters
Determine
H1 corr ρ
0.1
Total sample size

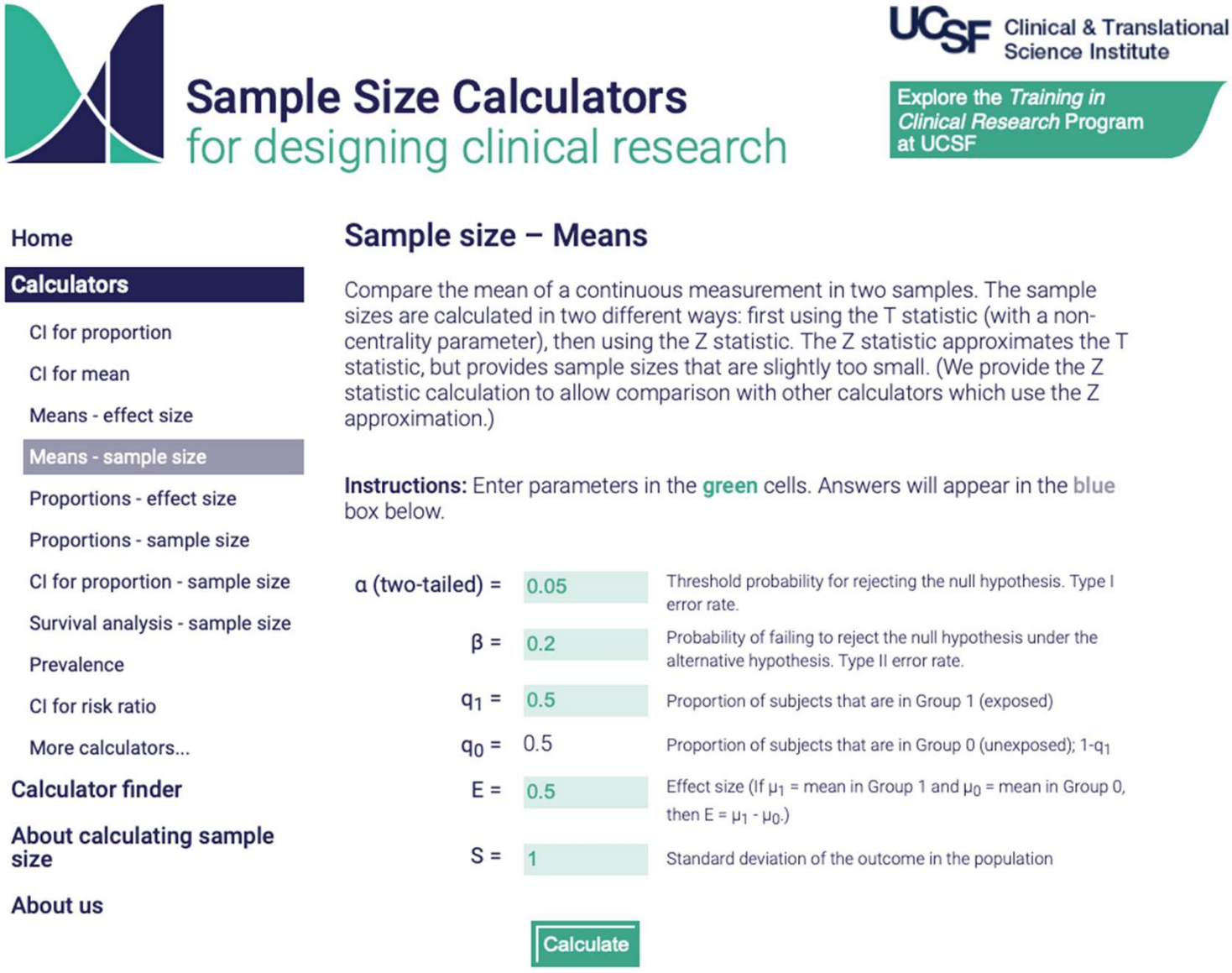
Web application

https://www.ai-therapy.com/psychology-statistics/sample-size-calculator



Web application

https://sample-size.net/sample-size-means/



Web application

https://www.danielsoper.com/statcalc/calculator.aspx?id=89

A-priori Sample Size Calculator for Structural Equation Models

This calculator will compute the sample size required for a study that uses a structural equation model (SEM), given the number of observed and latent variables in the model, the anticipated effect size, and the desired probability and statistical power levels. The calculator will return both the minimum sample size required to detect the specified effect, and the minimum sample size required given the structural complexity of the model.

Please enter the necessary parameter values, and then click 'Calculate'.

Anticipated effect size:	0.1
Desired statistical power level:	0.8
Number of latent variables:	2
Number of observed variables:	10
Probability level:	0.05

Calculate!

Related Resources

x^2 Formulas References Related Calculators Search

Web application

https://www.statulator.com/SampleSize/ss1P.html

Statulator | Sample Size | Descriptive Analysis | Statistical Tests

Sample Size Calculator for Estimating a Single Proportion

- ✔ Provides live interpretations.
- ✔ Assesses the influence of changing input values.
- ✔ Adjusts sample sizes for finite population and clustering.

Calculator | Visualisation | Tabulate

Input Values

Specify input values and click Calculate. Hover over the sign to obtain help.

Level of Confidence

0.95

Expected Proportion

0.50

Precision or Margin of Error

Absolute value | 0.05

Note: You may adjust sample sizes for finite population, clustering and response rate by clicking the 'Adjust' button below.

Calculate | Adjust | Reset

Calculator | Visualisation | Tabulate

Influence of Changing Input values on Sample Size Estimates

Customize Visualisation
Customize the plot by changing input values from here.

Level of Confidence

0.95

Expected Proportion (x-axis)

From Min	To Max	By
0.05	0.95	0.01

Specify Levels of Precision (Margin of Error) as

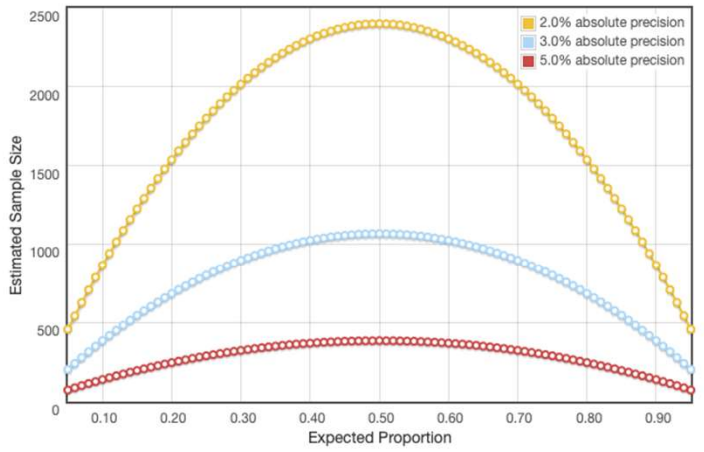
(Select)	1st Series	2nd Series	3rd Series
Absolute	0.02	0.03	0.05

You may adjust sample size for clustering, finite population and response rate by clicking the Adjust button below.

Customize | Adjust | Reset Form

Visualisation
This visualisation assumes a 95% level of confidence and plots sample sizes for three precision levels of 2, 3 and 5 percent. You may change the default values from the panel on the left.

Download Figure



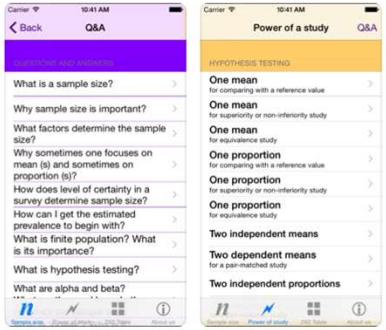
Note: You may adjust the calculated sample size for clustering, response rate or finite population by clicking here or the 'Adjust' button.

Mobile application

n4Studies

Education

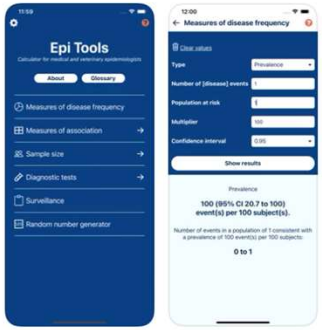
★★★★★ 27



Epi Tools

Epidemiology Calculation T...

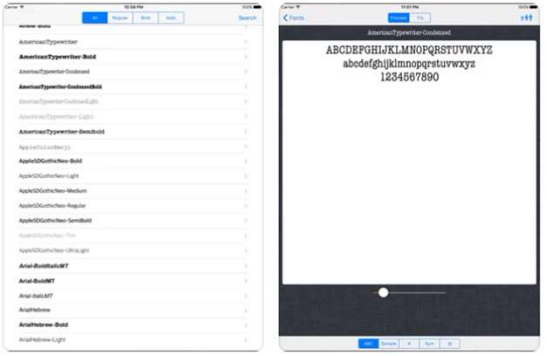
GET



Font preview tool.

Utilities

GET



Sample Size Calcula...

Education

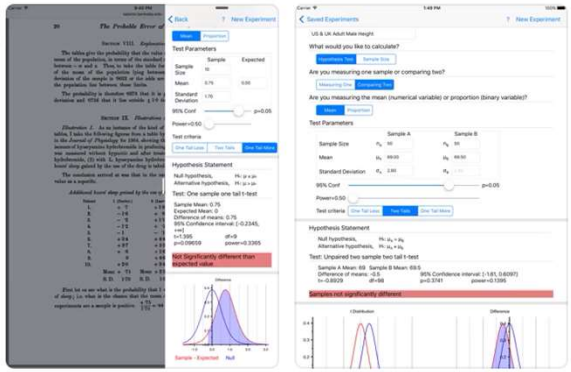
★☆☆☆☆ 1

฿35.00

Power Analysis

Easy guided statistical tests

฿179.00

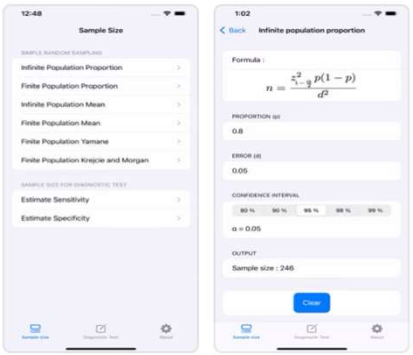


Sample Tools

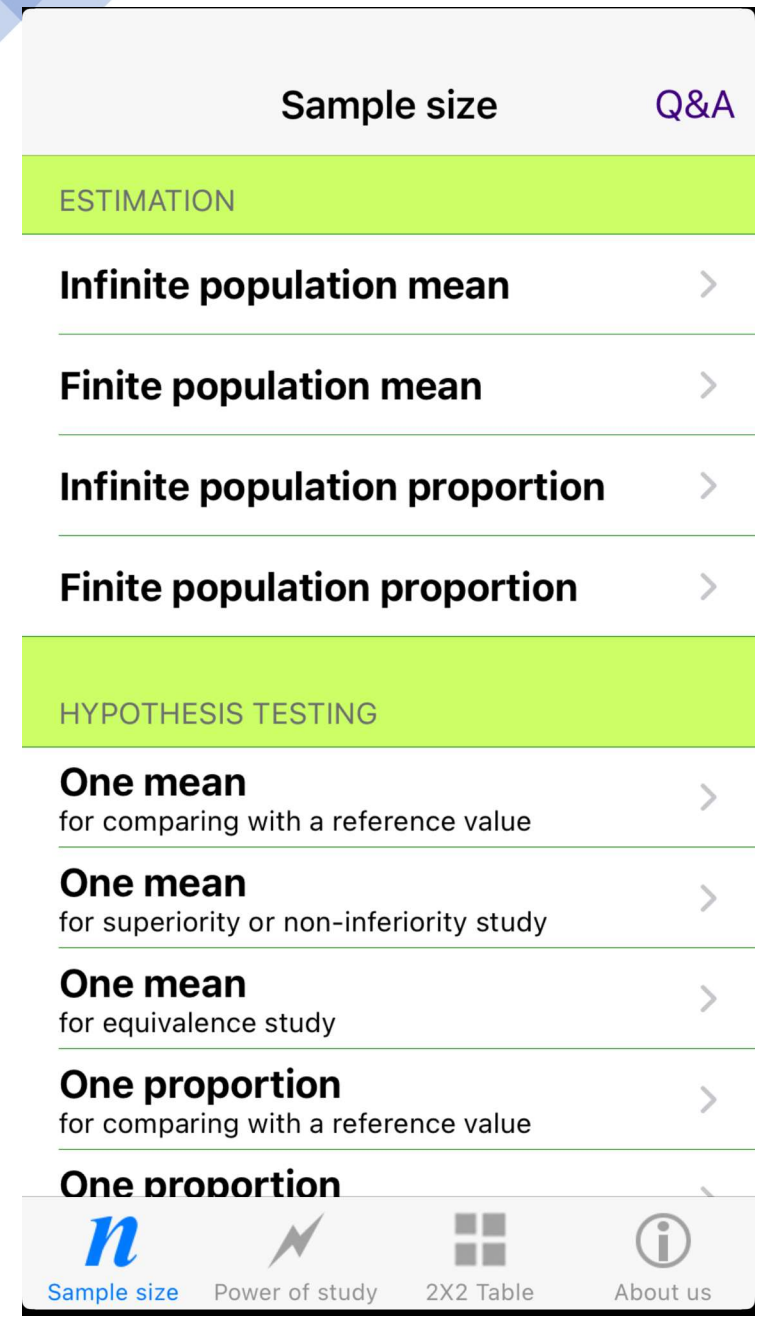
Education

★★★★★ 1

GET

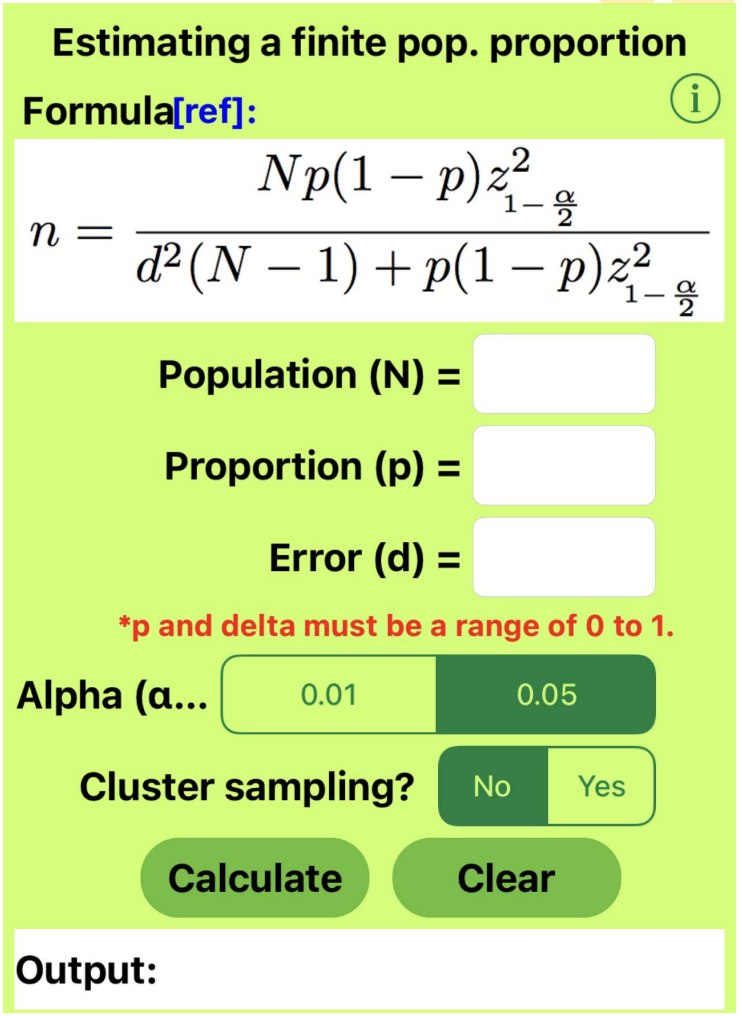


Mobile application



N4studies

ผศ.ดร. รศ.ดร.เชษฐา งามจรัส



Mobile application

- **One mean**
  for comparing with a reference value
- **One mean**
  for superiority or non-inferiority study
- **One mean**
  for equivalence study
- **One proportion**
  for comparing with a reference value
- **One proportion**
  for superiority or non-inferiority study
- **One proportion**
  for equivalence study
- **Two independent means**
- **Two dependent means**
  for a pair-matched study
- **Two independent proportions**
- **Two dependent proportions**
  for a pair-matched study

Two independent proportions

Formula (without continuity correction) [ref]:

$$n_1 = \left[\frac{z_{1-\frac{\alpha}{2}}\sqrt{\bar{p}\bar{q}\left(1+\frac{1}{r}\right)}+z_{1-\beta}\sqrt{p_1 q_1+\frac{p_2 q_2}{r}}}{\Delta}\right]^2$$

$$r = \frac{n_2}{n_1}, q_1 = 1-p_1, q_2 = 1-p_2$$

$$\bar{p} = \frac{p_1+p_2 r}{1+r}, \bar{q} = 1-\bar{p}$$

Proportion in group1 (p1...

Proportion in group2 (p...

*p_1 and p_2 must be a range of 0 to 1.

Ratio (r) = 1

Alpha (α... 0.01 | 0.05

Beta (β) = 0.1 | 0.2

References

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