

การคำนวณขนาดตัวอย่าง สำหรับการวิจัยในมนุษย์

Dr.Wanlop Jaidee

Major of Community-Public Health , Faculty of Public Health, Burapha University

หัวข้อวันนี้



พื้นฐานของวิจัยและ
สถิติที่ใช้สำหรับการ
คำนวณขนาดตัวอย่าง



หลักการพิจารณาเลือก
วิธีการคำนวณขนาด
ตัวอย่างที่เหมาะสมกับ
รูปแบบการวิจัย



การใช้โปรแกรมหรือ
แอปพลิเคชันสำเร็จรูป
ในการคำนวณขนาด
ตัวอย่าง

พื้นฐานของวิจัยและสถิติที่ใช้ สำหรับการคำนวณขนาดตัวอย่าง



Types of study design



```
graph TD; A[Types of study design] --> B[Number of contracts]; A --> C[Reference period]; A --> D[Nature of the investigation]; B --> B1[Cross-sectional]; B --> B2[Before-after]; B --> B3[Longitudinal]; C --> C1[Retrospective]; C --> C2[Prospective]; C --> C3[Retro-prosective]; D --> D1[Experimental]; D --> D2[Non-experimental (Observational)];
```

The diagram is a hierarchical flowchart titled "Types of study design". It starts with a central blue box at the top. Three arrows point downwards from this box to three separate blue boxes: "Number of contracts", "Reference period", and "Nature of the investigation". From each of these three boxes, a vertical line leads to a cyan box. From each of these cyan boxes, a vertical line leads to two more cyan boxes, representing sub-categories. The "Number of contracts" branch includes "Cross-sectional", "Before-after", and "Longitudinal". The "Reference period" branch includes "Retrospective", "Prospective", and "Retro-prosective". The "Nature of the investigation" branch includes "Experimental" and "Non-experimental (Observational)". The diagram is decorated with light blue and light green geometric shapes in the corners.

Number of contracts

Cross-sectional

Before-after

Longitudinal

Reference period

Retrospective

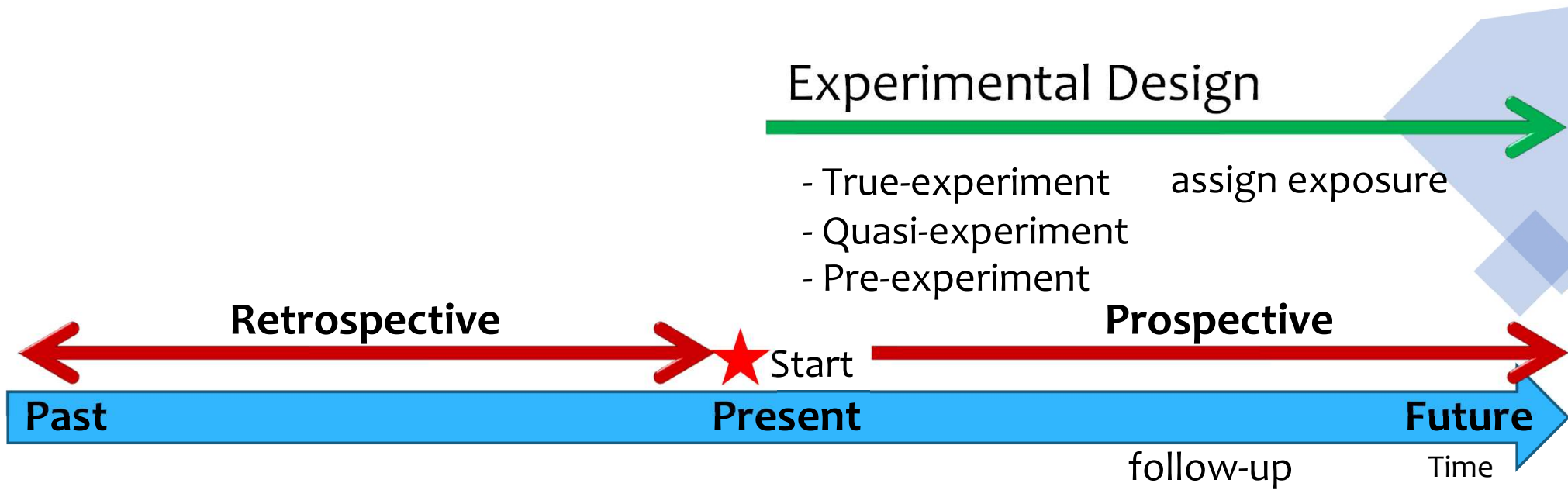
Prospective

Retro-prosective

Nature of the investigation

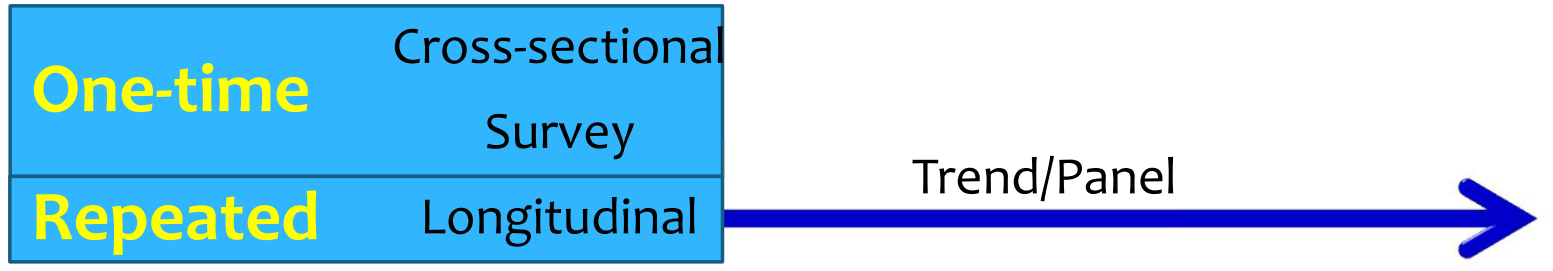
Experimental

Non-experimental
(Observational)

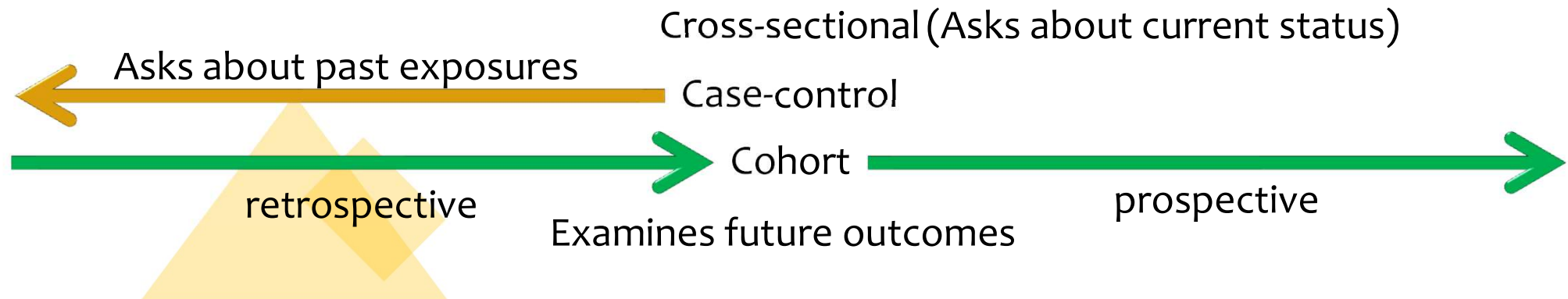


Observational Design (Descriptive)

- 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?

We want to know about these

We have these
to study with

Population

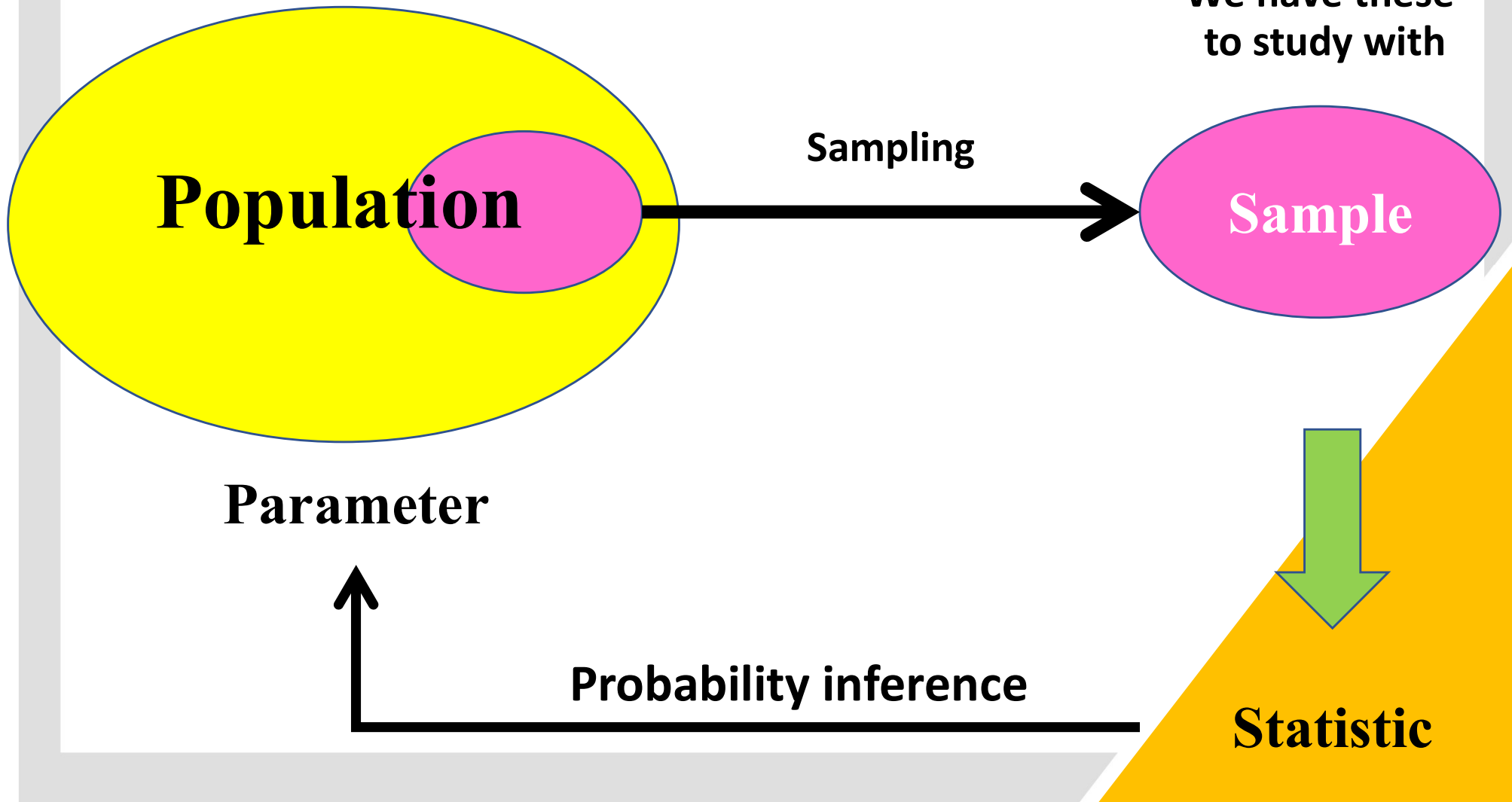
Sampling

Sample

Parameter

Probability inference

Statistic



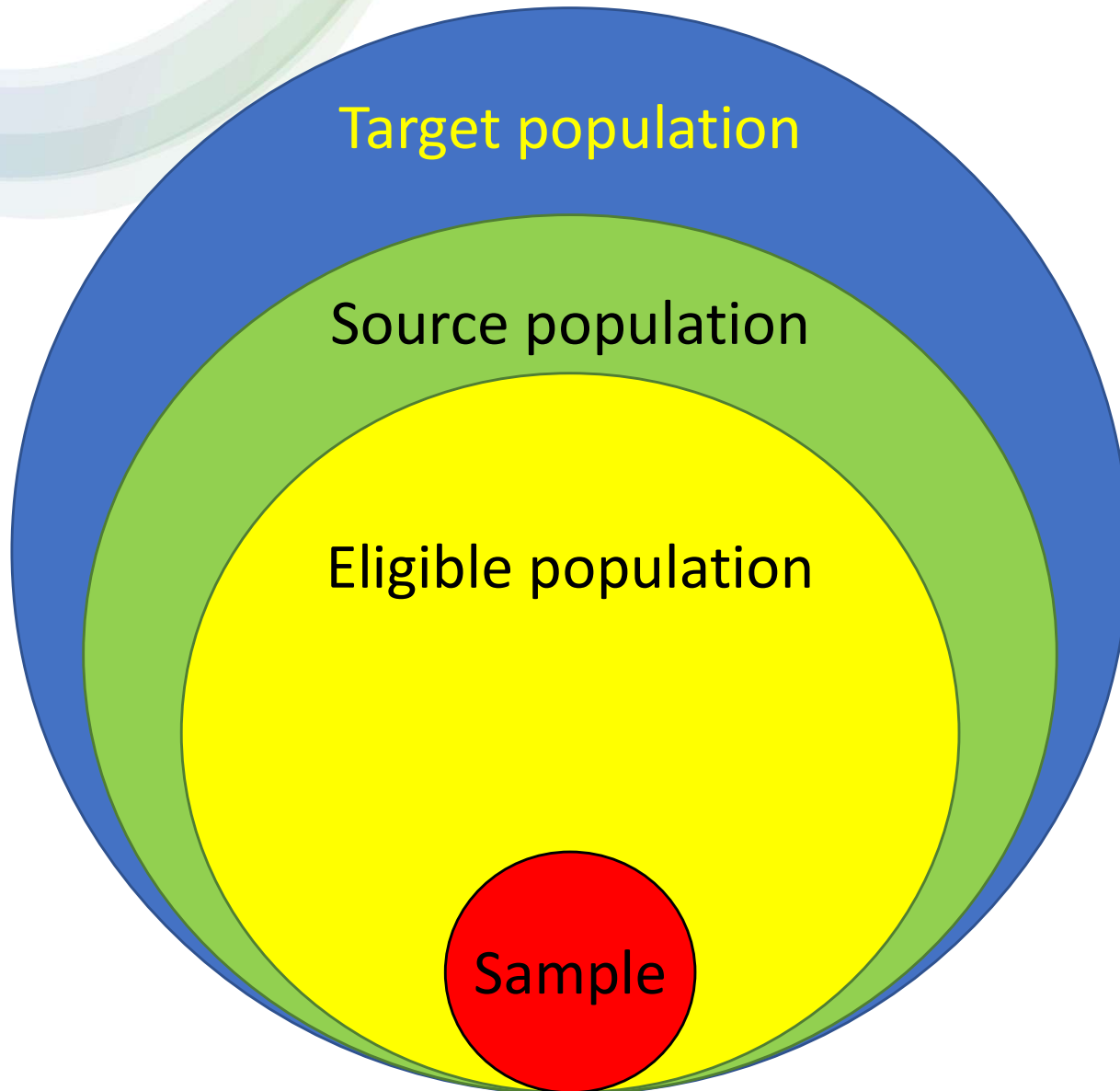
Population

- 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**

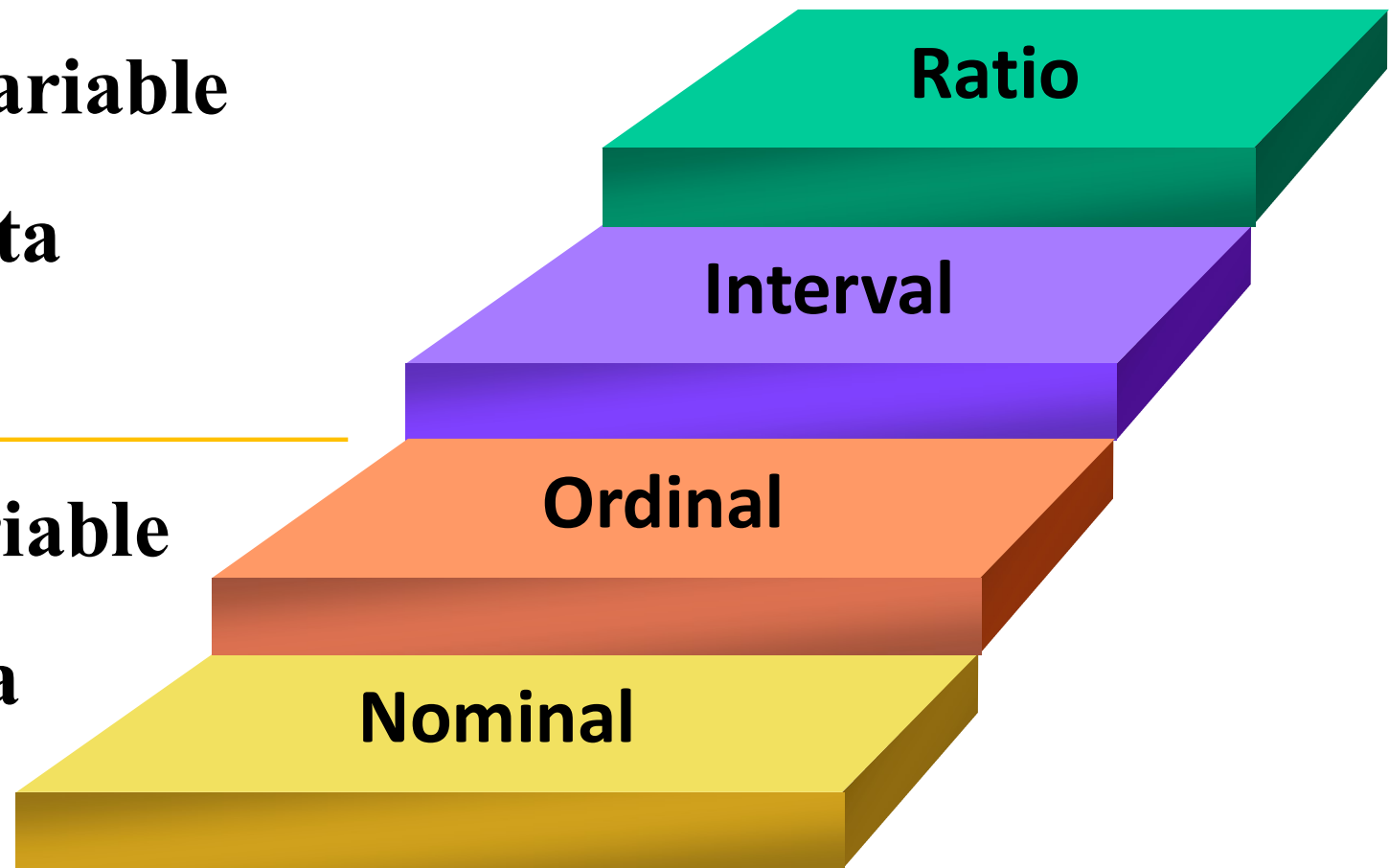
Measurement levels

- **Quantitative variable**

- **Continuous data**

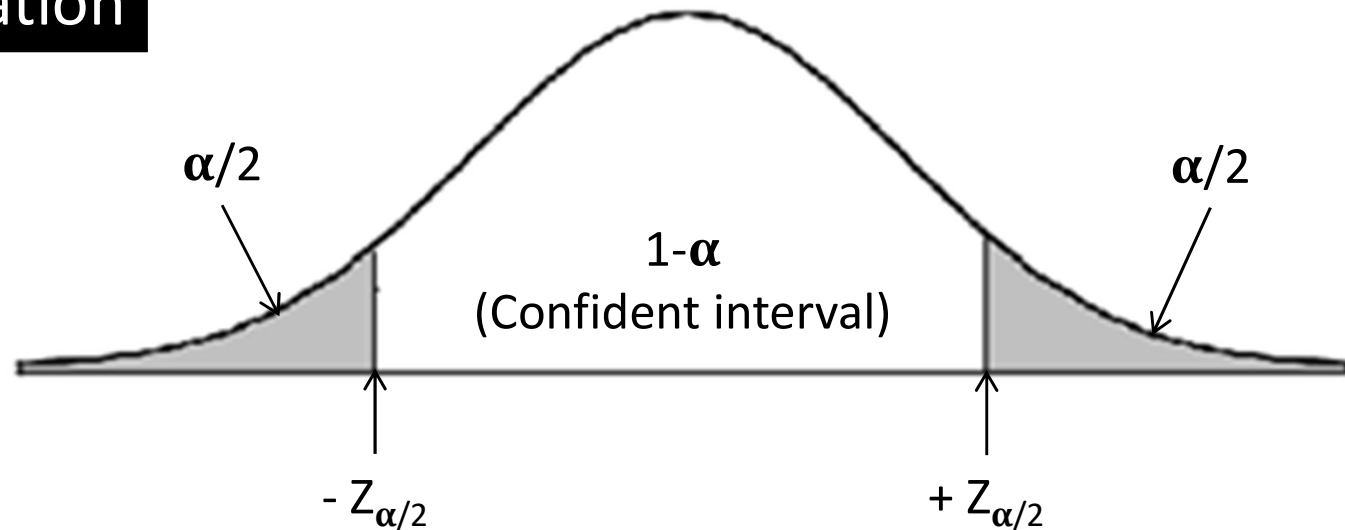
- **Qualitative variable**

- **Categories data**

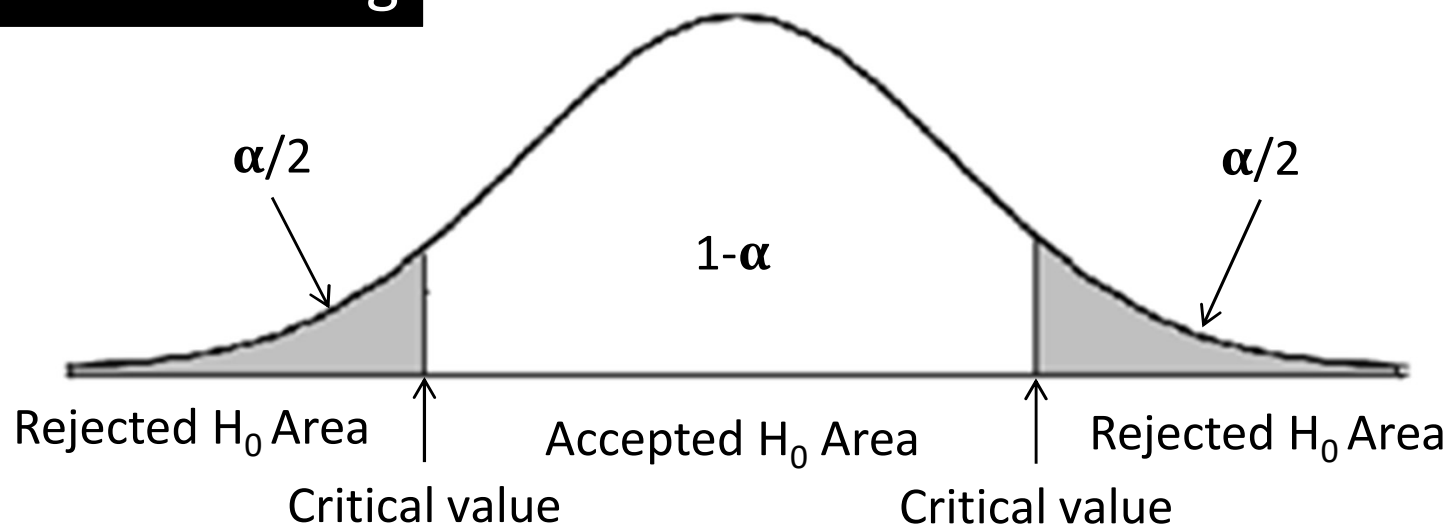


Inferential Statistics

Estimation



Hypothesis testing

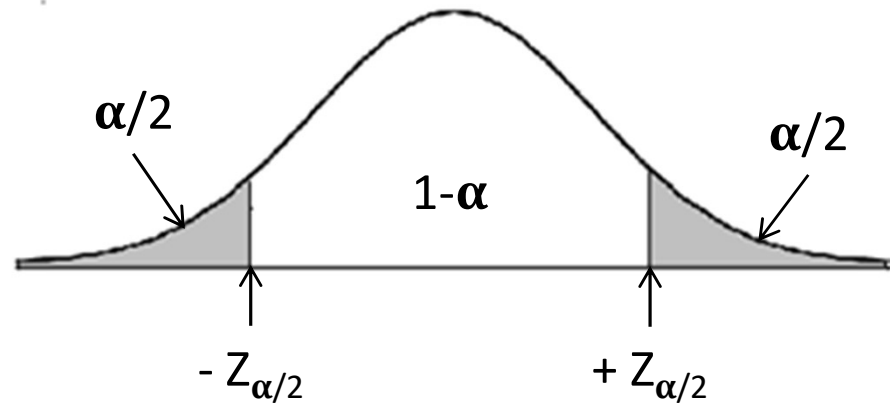


Statistical Hypothesis

- Two-tail (two-side)

$$H_0: \mu = \mu_0$$

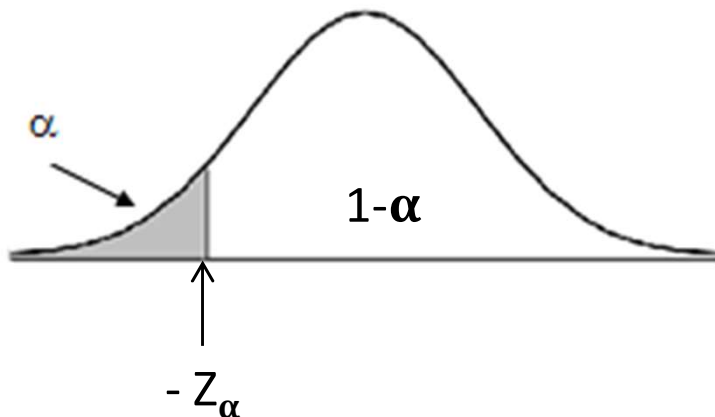
$$H_A: \mu \neq \mu_0$$



- One-tail (one-side)

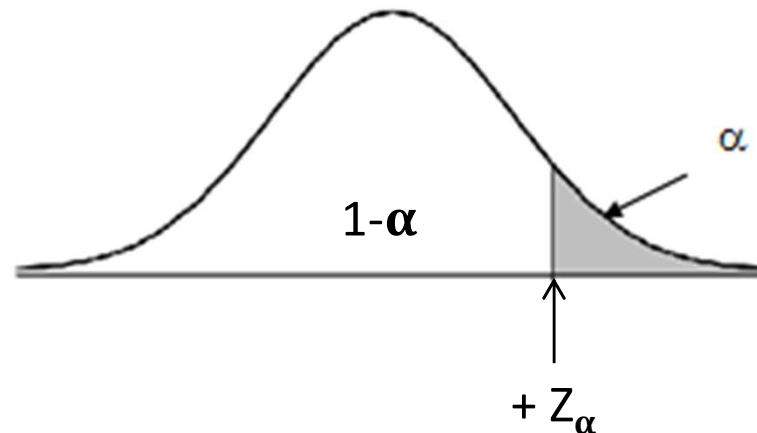
$$H_0: \mu \geq \mu_0$$

$$H_A: \mu < \mu_0$$



$$H_0: \mu \leq \mu_0$$

$$H_A: \mu > \mu_0$$



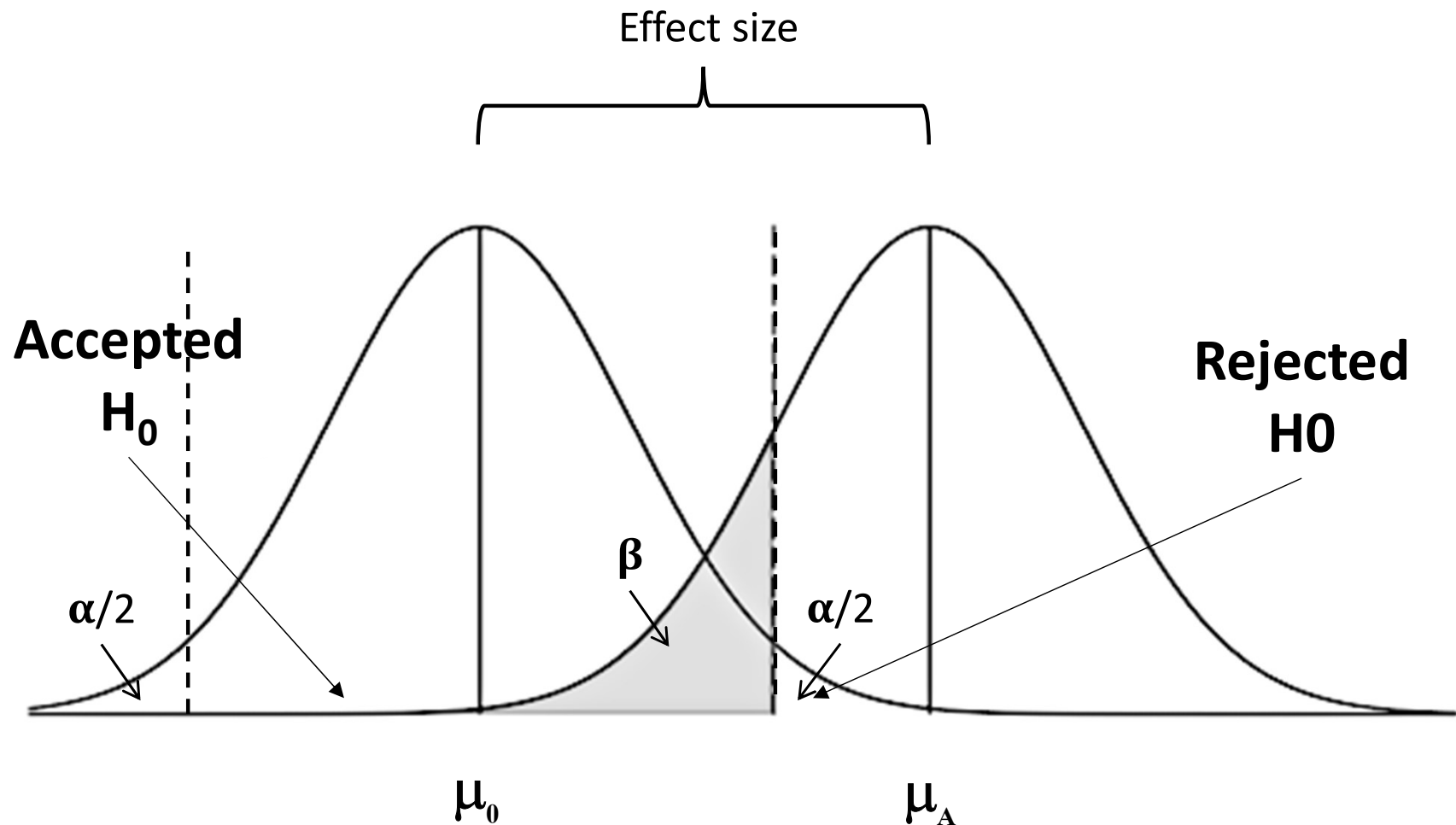
Significance and power

Truth (real world)

Decision (statistical analysis)

	H_0 true No difference	H_0 false Difference
Accepted H_0	Correct decision (CI) = $1 - \alpha$	Type II error = β
Reject H_0	Type I error level ($\alpha \Rightarrow$ significance)	Correct decision (power) = $1 - \beta$

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 ($1-\beta$)

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)

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

When n_0 : number of sample

and $d = e$

d : precision of estimation

e : acceptable sampling error

Sample size equation (general)

Finite population correction

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

When N : number of population

n_0 : initial sample size

n : adjusted sample size

Sample size equation for estimation


Mean estimation

- Infinite population

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

- Finite population

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


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

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% ($\alpha=0.05$)
ความคลาดเคลื่อนสัมพัทธ์ไม่เกิน 5% ($\epsilon=0.05$)
- เมื่อกำหนด $\alpha = 0.05 \Rightarrow Z_{\alpha/2} = 1.96$
- $d = \text{mean} * \epsilon = 2800 * 0.05 = 140$
- $\sigma = \text{s.d.} = 500$
- แทนค่า

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

ดังนั้นจะต้องสุ่มทารกแรกคลอดมาจำนวน 49 คน

Sample size equation for estimation


Proportion estimation

- Infinite population

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

- Finite population

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


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

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% ($\alpha=0.05$)
ความคลาดเคลื่อนที่ยอมให้เกิดขึ้นได้ไม่เกิน 5% ($e=0.05$)
- เมื่อกำหนด $\alpha = 0.05 \Rightarrow Z_{\alpha/2} = 1.96$
- แทนค่า

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

ดังนั้นจะต้องสุ่มผู้ชายวัยกลางคนมาจำนวน 84 คน

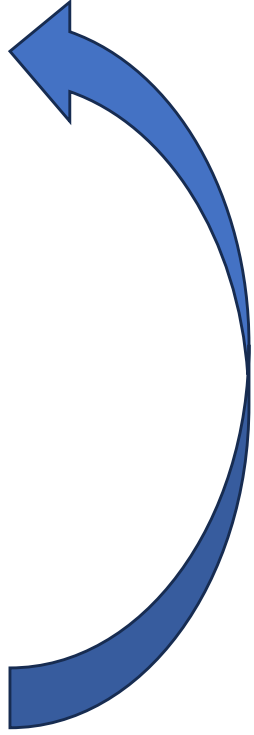
Sample size equation for estimation

A simplified formula for proportions

- Taro Yamane (1967)

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

Define: $Z^2_{\alpha/2} = 2$
 $\pi = 0.5$

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


Sample size equation for estimation

A simplified formula for proportions

- Krejcie & Morgan (1970)

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

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

$\pi = 0.5$

$d = 0.05$

Sample size equation for hypothesis testing

mean difference of one group

Hypothesis

$$H_0 : \mu = \mu_0$$

$$H_A : \mu \neq \mu_0$$

$$H_0 : \mu \leq \mu_0 \quad \text{หรือ} \quad H_0 : \mu \geq \mu_0$$

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

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

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

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

$$H_0 : \mu_D = 0$$

$$H_A : \mu_D \neq 0$$

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

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

$$H_0 : \rho = 0$$

$$H_A : \rho \neq 0$$

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

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

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

Sample size equation for hypothesis testing

Effect size (Cohen's d)

one group difference

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

two independent group difference

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

Sample size equation for Regression

Linear regression

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

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

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

λ : beta coefficient

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

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

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

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

when R^2 : Pseudo R^2

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

$$n = 50 + 8 \times \#coefficients$$



Parameter in equation

Consider from:

- 1st outcome
- important variable
- higher variance

Find parameter from:

- Previous research
- Database register
- Pilot study

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

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



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 ($z = 0.15$; $p = 0.88$).

අවහුරුමයාදාන => one-group Experiment
pre-post test

නිර්ණායක sample size

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

$n = 27$ $\mu_d = \text{pre-post}$

$\alpha = 0.05$

$\beta = 0.20$

ඵ $\sigma_d = \left(\frac{U_L - d}{t_{\alpha/2, n-1}} \right) \sqrt{n}$
 $= \left(\frac{0.39 - 0.24}{2.055} \right) \sqrt{27}$
 $= 0.379$

$t_{0.025, 26} = 2.055$

ඵ $\alpha = 0.05 \Rightarrow Z_{\alpha/2} = 1.96$

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

ඵ $\beta = 0.10 \Rightarrow Z_{\beta} = 1.29$

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

$n = \frac{(1.96 + 1.29)^2 (0.379)^2}{(0.24)^2} = 29$

Previous Page

การเลือกสูตรคำนวณขนาดตัวอย่าง จ: พิจารณาจาก วัตถุประสงค์การวิจัย

① เพื่อประมาณค่า → design = descriptive study

มักจะเป็นการสำรวจ / ทราบสถานการณ์

$$n = \frac{Z_{\alpha/2}^2 \sigma^2}{d^2}$$

* ใช้สูตรนี้เมื่อเป็น continuous outcome

หรือ: มักจะนิยมตามตรงจำนวนประชากร

② เพื่อทดสอบสมมติฐาน

↳ design = analytic study
↓
experimental study

เพื่อเปรียบเทียบผล → ด้านทางจิตใจ, ทัศนคติ

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

ซึ่งไม่มีการตามตรงด้วยจำนวน population

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

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

$Z_{\beta} \Rightarrow \beta = \text{Type II error}$
 $1 - \beta = \text{power of test}$

สูตรทางจิตใจ

ใช้ทั้ง $Z_{\alpha/2}$ หรือ Z_{β}

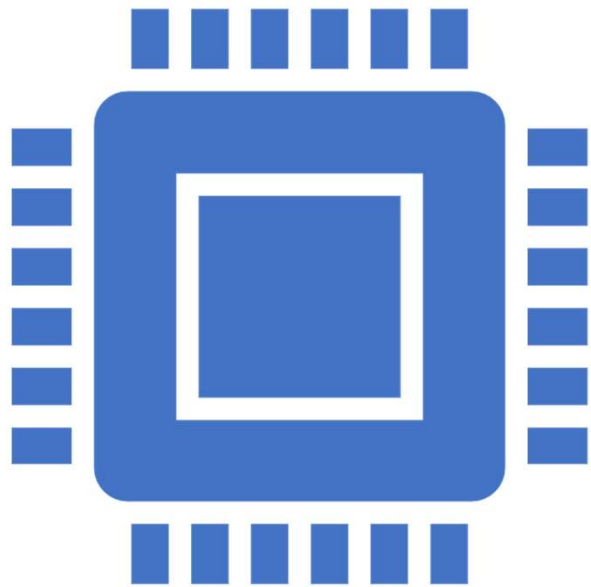
ใช้สำหรับเปรียบเทียบผล/ทดสอบสมมติฐาน

ซึ่งไม่มีการตามตรงด้วยจำนวนประชากร (N)

ใช้ตามผลวิจัย

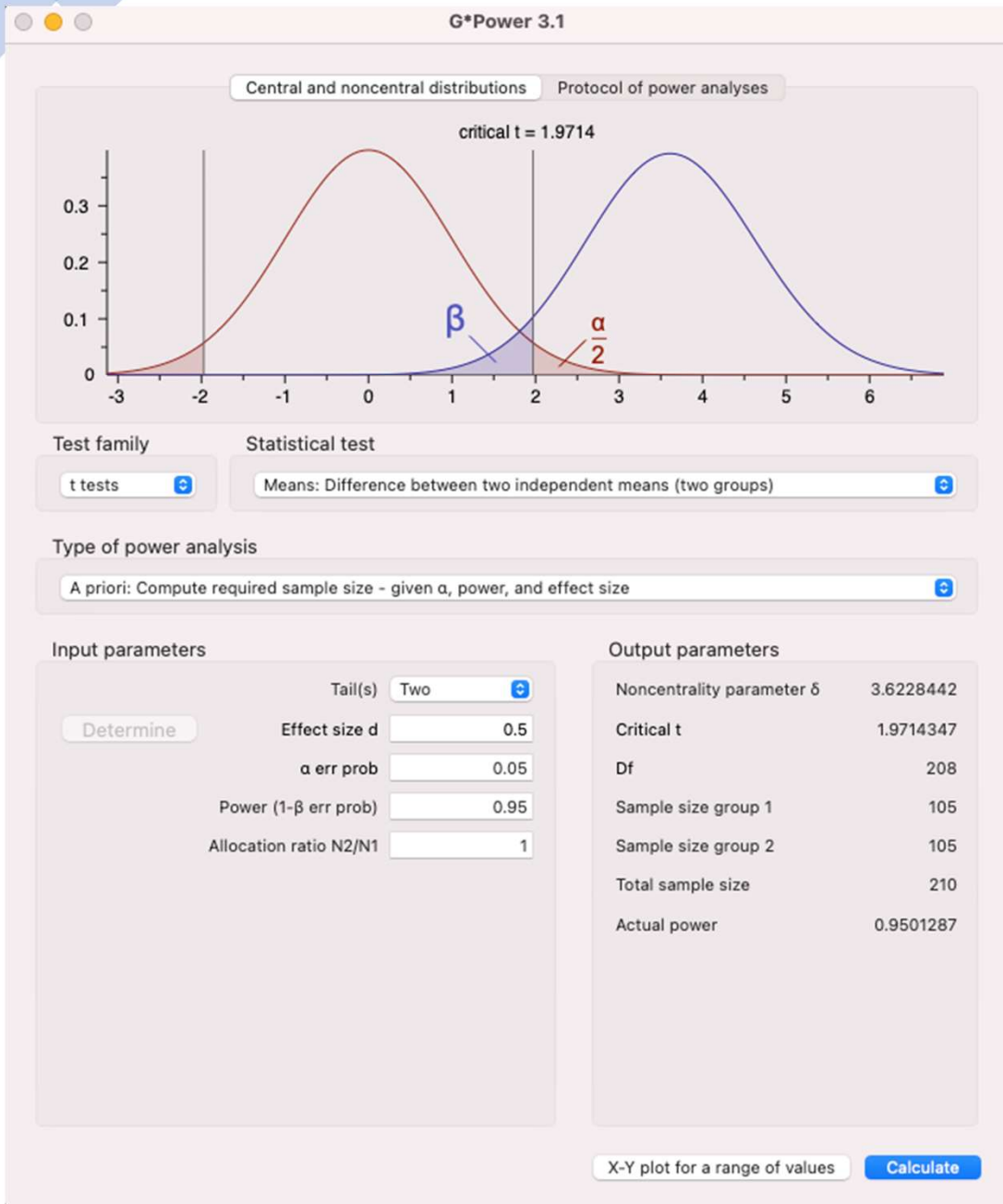
Sample size

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 $1-\beta$ of 0.2. To reach a power level of 80% 30 participants were required.



Software & Application

G*Power



n1 \neq 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

Type of power analysis

A priori: Compute required sample size

Input parameters

Determine

Statistical test

- ✓ 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

t tests

Type of power analysis

A priori: Compute required

Input parameters

Determine

Statistical test

- ✓ 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

Actual power

Test family

z tests

Type of power analysis

A priori: Compute required

Input parameters

Determine

Statistical test

- ✓ 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

H1 corr ρ

0.1

Total sample size

Web application

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

HYPOTHESIS TESTING

- Overview and terminology
- Comparing two sets of data
- Comparing more than two sets of data (ANOVA)

EFFECT SIZES AND POWER

- Effect size calculator
- Power calculator

Sample size calculator

PLOTTING

- ROC Curve

About AI-Therapy

AI-Therapy creates online fully automated programs using the latest evidence-based treatments, such as cognitive behavioural therapy. The social anxiety program has been tested with a randomized controlled trial. To find out more visit:

- [Overcome Social Anxiety](#)
- [Overcome Fertility Stress](#)
- [Overcome Death Anxiety](#)

A second approach is to use clinical judgment to specify the smallest effect size that you consider to be relevant. For example, if you feel that it is important to detect even small effects, you may select a value of 0.2 (see [this page](#) for a rough categorization of effect size levels).

Sample size calculator

This calculator tells you the minimum number of participants necessary to achieve a given power. The following parameters must be set:

Test family The online calculator currently supports the *t*-test and sample size estimation for correlation co-efficients. Please [contact us](#) if there are other test families that you would like included.

Sample groups Select the "Same subjects" option if you will take multiple measurements from the same person (this is sometimes known as "paired", "related" or "repeated measures"), and "Independent groups" if the scores will be from two different groups of people.

Tail(s) The number of tails depends on whether or not your hypothesis has an implied direction. There is more information on directionality [here](#).

Effect size See the discussion above to select an appropriate effect size.

Significance level Alpha (α) is the probability of falsely rejecting the null hypothesis, and the most common value is 0.05. A more thorough discussion on setting the significance level can be found [here](#).

Power [Statistical power](#) is the ability of study to detect a result that exists in nature. Generally, we want power to be as high as possible. However, setting it too high may result in a sample size that is not practical. A value of 0.8 is often used in practice.

Test family

Sample groups

Number of tails

Effect size

Significance level (α)

Power

Web application

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



Sample Size Calculators for designing clinical research

UCSF Clinical & Translational
Science Institute

Explore the *Training in
Clinical Research Program*
at UCSF

Home

Calculators

CI for proportion

CI for mean

Means - effect size

Means - sample size

Proportions - effect size

Proportions - sample size

CI for proportion - sample size

Survival analysis - sample size

Prevalence

CI for risk ratio

More calculators...

Calculator finder

About calculating sample
size

About us

Sample size – Means

Compare the mean of a continuous measurement in two samples. The sample sizes are calculated in two different ways: first using the T statistic (with a non-centrality parameter), then using the Z statistic. The Z statistic approximates the T statistic, but provides sample sizes that are slightly too small. (We provide the Z statistic calculation to allow comparison with other calculators which use the Z approximation.)

Instructions: Enter parameters in the **green** cells. Answers will appear in the **blue** box below.

α (two-tailed) =	0.05	Threshold probability for rejecting the null hypothesis. Type I error rate.
β =	0.2	Probability of failing to reject the null hypothesis under the alternative hypothesis. Type II error rate.
q_1 =	0.5	Proportion of subjects that are in Group 1 (exposed)
q_0 =	0.5	Proportion of subjects that are in Group 0 (unexposed); $1 - q_1$
E =	0.5	Effect size (If μ_1 = mean in Group 1 and μ_0 = mean in Group 0, then $E = \mu_1 - \mu_0$.)
S =	1	Standard deviation of the outcome in the population

Calculate






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:	<input type="text" value="0.1"/>	
Desired statistical power level:	<input type="text" value="0.8"/>	
Number of latent variables:	<input type="text" value="2"/>	
Number of observed variables:	<input type="text" value="10"/>	
Probability level:	<input type="text" value="0.05"/>	
<input type="button" value="Calculate!"/>		

▶ Related Resources

[x² Formulas](#)

[References](#)

[Related Calculators](#)

[Search](#)

Web application

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

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

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: 0.05 To Max: 0.95 By: 0.01

Specify Levels of Precision (Margin of Error) as ?

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

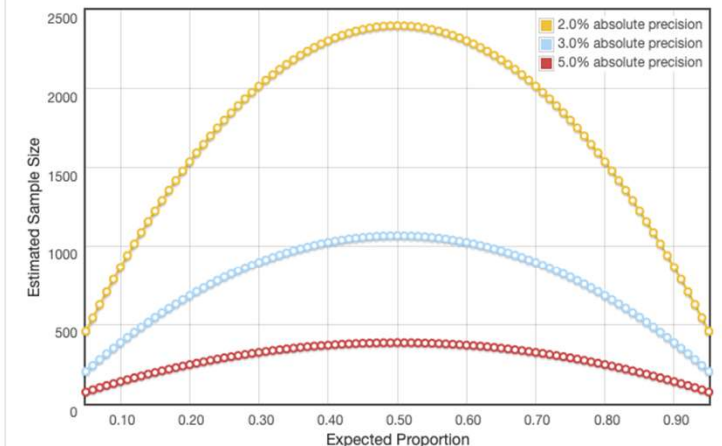
You may adjust sample size for clustering, finite population and response rate by clicking the Adjust button below.

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.

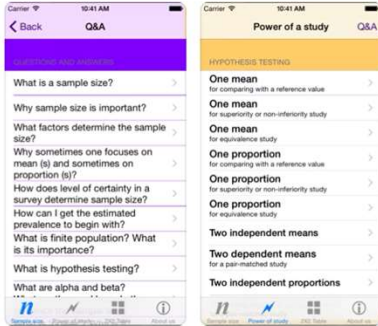
Download Figure



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

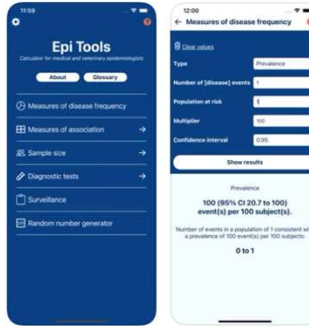
Mobile application

n4Studies
Education
★★★★★ 27



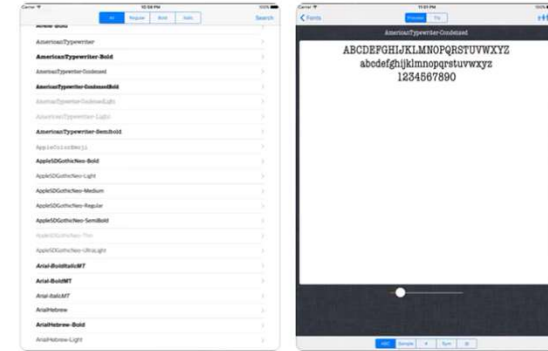
Epi Tools
Epidemiology Calculation T...

GET



Font preview tool.
Utilities

GET



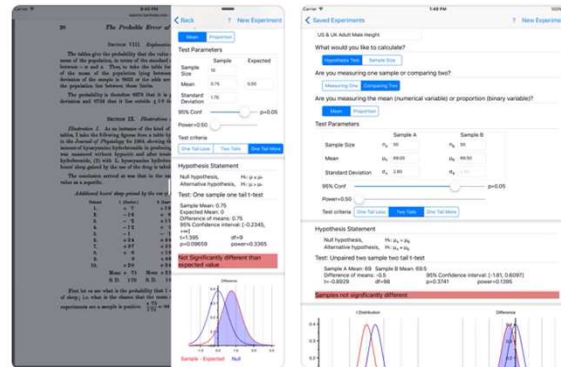
Sample Size Calcula...
Education
☆☆☆☆☆ 1

\$35.00



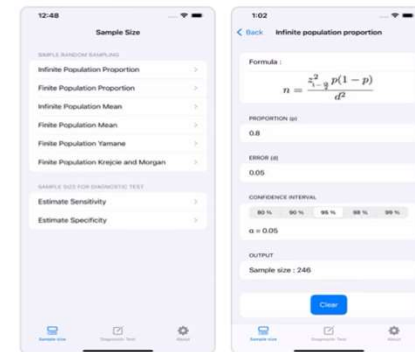
Power Analysis
Easy guided statistical tests

\$179.00



Sample Tools
Education
★★★★★ 1

GET



Mobile application

Sample size

Q&A

ESTIMATION

Infinite population mean >

Finite population mean >

Infinite population proportion >

Finite population proportion >

HYPOTHESIS TESTING

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 >



Sample size



Power of study



2X2 Table



About us

N4studies

ผศ.ดร. วศ.ดร.เชษฐา งามจรัส

Estimating a finite pop. proportion

Formula[ref]:



$$n = \frac{Np(1-p)z_{1-\frac{\alpha}{2}}^2}{d^2(N-1) + p(1-p)z_{1-\frac{\alpha}{2}}^2}$$

Population (N) =

Proportion (p) =

Error (d) =

*p and delta must be a range of 0 to 1.

Alpha (α...)

0.01

0.05

Cluster sampling?

No

Yes

Calculate

Clear

Output:

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)[\[ref\]](#):



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

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

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

Proportion in group1 (p1...

Proportion in group2 (p...

***p₁ and p₂ must be a range of 0 to 1.**

Ratio (r) =

Alpha (α...

0.01

0.05

Beta (β) =

0.1

0.2

References

- Chow, S-C, J Sao , & H Wang . (2008). Sample Size Calculations in Clinical Research. 2nd Ed. United States of America: Taylor & Francis Group.
- Cochran, WG. (1963). Sampling Techniques. 2nd Ed. New York: John Wiley and Sons, Inc.
- Cohen, J. (1988). Statistical Power Analysis for the Behavioral Sciences. Routledge.
- Dupont, William D., and Walton D. Plummer. 'Power and Sample Size Calculations for Studies Involving Linear Regression', *Controlled Clinical Trials*, vol. 19/no. 6, (1998), pp. 589-601.
- Green, S.B. (1991). How many subjects does it take to do a regression analysis?. *Multivariate Behavioral Research*, 26, 499-510.
- 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.
- Krejcie, RV, & DW Morgan. (1970). Determining Sample Size for Research Activities. *Educational and Psychological Measurement*.
- Yamane, T. (1967). *Statistics, An Introductory Analysis*, 2nd Ed., New York: Harper and Row.