Science DynamicsMasterclass
© 2025 Science Dynamics
Research Labs, Proverbs a.s.

10 - Inferences involving the Mean when sigma is known

Interval Estimation

95% of sample means falls within 1.96 standard deviations of the population mean

$$\bar{X} - z_c \frac{\sigma}{\sqrt{N}} \le \mu \le \bar{X} + z_c \frac{\sigma}{\sqrt{N}}$$

Confidence Interval for mi (population mean)

- Zc= 1.645 for a 90%CI
- 1.960 for a 95 CI
- 2.576 for a 99 % CI

CI can be used for hypotheses testing

CI can be use...
if the value is outside the confidence interval we can reject null hypothesis

Relation of CI level of confidence and N

- increase of the confidence level prolongs the CI
- increase N and Confidence level the same, resulting CI is shorter
- decrease in CI, the same N, confidence level decreases

Hypothesis Testing

- Alternative Hypothesis H1
- Null Hypothesis H0
- SPSS
- p-value of the test
- z-test

z-test
based on z-score formula, in general a hypothesis test of the parameter mi when sigma is known

- significance level - alpha
  - 0.1
  - 0.05
  - 0.01
  - if p<alpha we reject null hypothesis
  - if p>alpha we retain null hypothesis
- one-tailed test

one-tailed test
when appropriate p-value lays on the left (<x) or on the right (>x) under the normal curve

- two-tailed test

two-taile...
when Ho = X and H1 is not equal X

Effect Size

$$d = \frac{\bar{X} - \mu}{\sigma}$$

Effect Size
practical significance of the result

- .20 small effect size
- 0.5 medium effect size
- 0.8 large effect size
- delta - the difference between curves of Ho and H1 / set up by researcher is practical significance= minimum effect size
- increase the standard error of the means sigma with alpha and delta constant decreases the power

ERRORS

- Type I error (α)

Type I error
Ho is true but we reject it

- Type II error (β)

Type II error
Ho is false but we retain it.

risk of committing type II error equals to Beta

- Power of the Test
  - 1-beta
  - probability of correct decision
  - power >.8 is used
  - the best way to increase the power is to increase N

Effect Size (Cohen's d)	Sample Size (N)
.2	196
.5	31
.8	12

Example of sample sizes to obtain power 0.8 with alpha 0.05