2.- Power

- The probability of rejecting $H_0$ when $H_0$ is false and $H_1$ is true.
- Effect: Any difference between a true and a hypothesized population mean

- The power of a statistical test is given by $1 - \beta$
- The power of the test determines the probability of detecting a particular effect

II. Inferential Statistics (6)

- Estimation
- Confidence Intervals

1.- Estimation

- Statistical Estimation
  - A form of Inferential Statistics which consists in estimating a parameter of a population from a corresponding sample statistic
- Two forms:
  - Point estimate
  - Confidence interval (CI)

Estimation

- Point estimate
  - Estimating the value of a parameter as a single point from the value of the statistic
  - Example: the observed sample mean as the point estimate of the mean of a population ($\mu$)
- Confidence Interval
  - Is a range of values that, with a known degree of certainty, includes the population parameter
2.- Confidence Intervals

- A range of values that, with a known degree of certainty, includes an unknown population characteristic (e.g., a population mean $\mu$)
- Level of confidence:
  - The percent of time a series of confidence intervals includes the unknown population characteristic (e.g., population mean)

Confidence Intervals (CI)

Why CIs work?

- They are built on three important properties of the sampling distribution of the mean
- The mean of the sampling distribution equals the unknown population mean
- The definition (and meaning) of the standard error of the mean
- The shape of the sampling distribution approximates a normal distribution

Confidence Intervals

- True Confidence Intervals
- False Confidence Intervals

In interval estimation, as the width of the interval decreases, statistical precision increases

- The width of the interval can be decreased by increasing the sample size
- As the level of confidence increases (e.g., from .95 to .99) the width of the interval also increases if other conditions are kept constant (e.g., same sample size)

Confidence Intervals (CI)

- CI for $\mu$ (based on $z$)
  Sample Mean $\pm (z_{conf})(\text{Standard error of the Mean})$

Example (Radioactive Score in Fresno, TEC$\delta$7), with a 95% level of confidence:
With $n = 100$, $104 \pm (1.96)(15/\sqrt{100}) = 101.06$; 106.94
With $n = 25$, $104 \pm (1.96)(15/\sqrt{25}) = 98.12$; 109.88
Confidence Intervals

- CI for $\mu$ based on $z$:
  - Assumptions
    - Population standard deviation $\sigma$ is known
    - Population is normal (or that the sample size is large enough to satisfy the requirements of the central limit theorem)

Hypothesis Tests or CIs?

- Hypothesis tests indicate whether or not an effect is present
- CIs indicate the possible size of the effect

II. Inferential Statistics (7)

- $t$ test for One Sample
- $t$ sampling distribution
- Example

1.- $t$ test for One Sample

- The $t$ test is used (rather than $z$ test) when:
  - The population standard deviation $\sigma$ is unknown
  - $\sigma$ must be estimated with the sample standard deviation $s$ (for inferential statistics)
  - The standard error of the mean $\sigma_x$ must be estimated with the estimated standard error of the mean $s_{\bar{x}}$

- $s = \sqrt{\frac{\sum (X - \bar{X})^2}{n-1}}$

- The standard error of the mean $\sigma_x$ must be estimated with the estimated standard error of the mean $s_{\bar{x}}$
  - $s_{\bar{x}} = \frac{s}{\sqrt{n}}$

$t$ test for One Sample

- $\sigma$ must be estimated with the sample standard deviation $s$
- $s = \sqrt{\frac{\sum (X - \bar{X})^2}{n-1}}$
- This version of the sample standard deviation is used for inferential statistics
- The standard error of the mean $\sigma_x$ must be estimated with the estimated standard error of the mean $s_{\bar{x}}$
  - $s_{\bar{x}} = \frac{s}{\sqrt{n}}$