# Application of Statistics in Educational Research I

# MPU1034

# *t* TESTS*

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main source: Vernoy & Vernoy (1997)

# Some Commonly Used Jargons…

- Comparison (Analysis) of Means
- *t* Scores and *t* Distribution
- Critical *t* Value
- Estimated Standard Deviation of the Population
- Estimated Standard Error of Mean
- Sampling Distribution of Differences Between Means
- Degree of Freedom
- Single-Sample *t* Test
- Independent-Samples *t* Test
- Correlated-Samples (Paired-Samples) *t* Test

# SAMPLING DISTRIBUTION OF MEANS

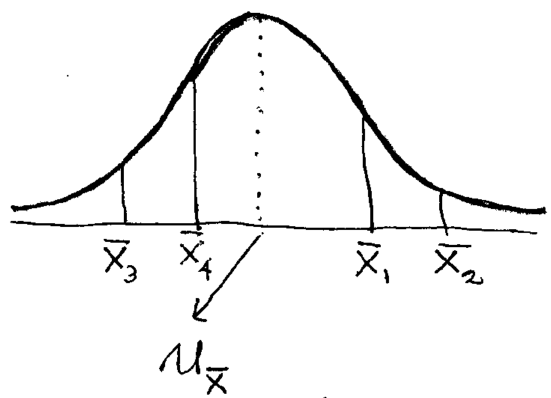
Suppose we are collecting data from various different samples (namely $S_1, S_2, S_3, \ldots$). The means of data from each sample are then computed and call them as

$$\overline{X_1}, \overline{X_2}, \overline{X_3}, \overline{X_4}, \ldots$$

- $\overline{X_1}$ → the mean of $S_1$
- $\overline{X_2}$ → the mean of $S_2$
- $\overline{X_3}$ → the mean of $S_3$
- $\overline{X_4}$ → the mean of $S_4$

Call these means as <u>sample means</u>.

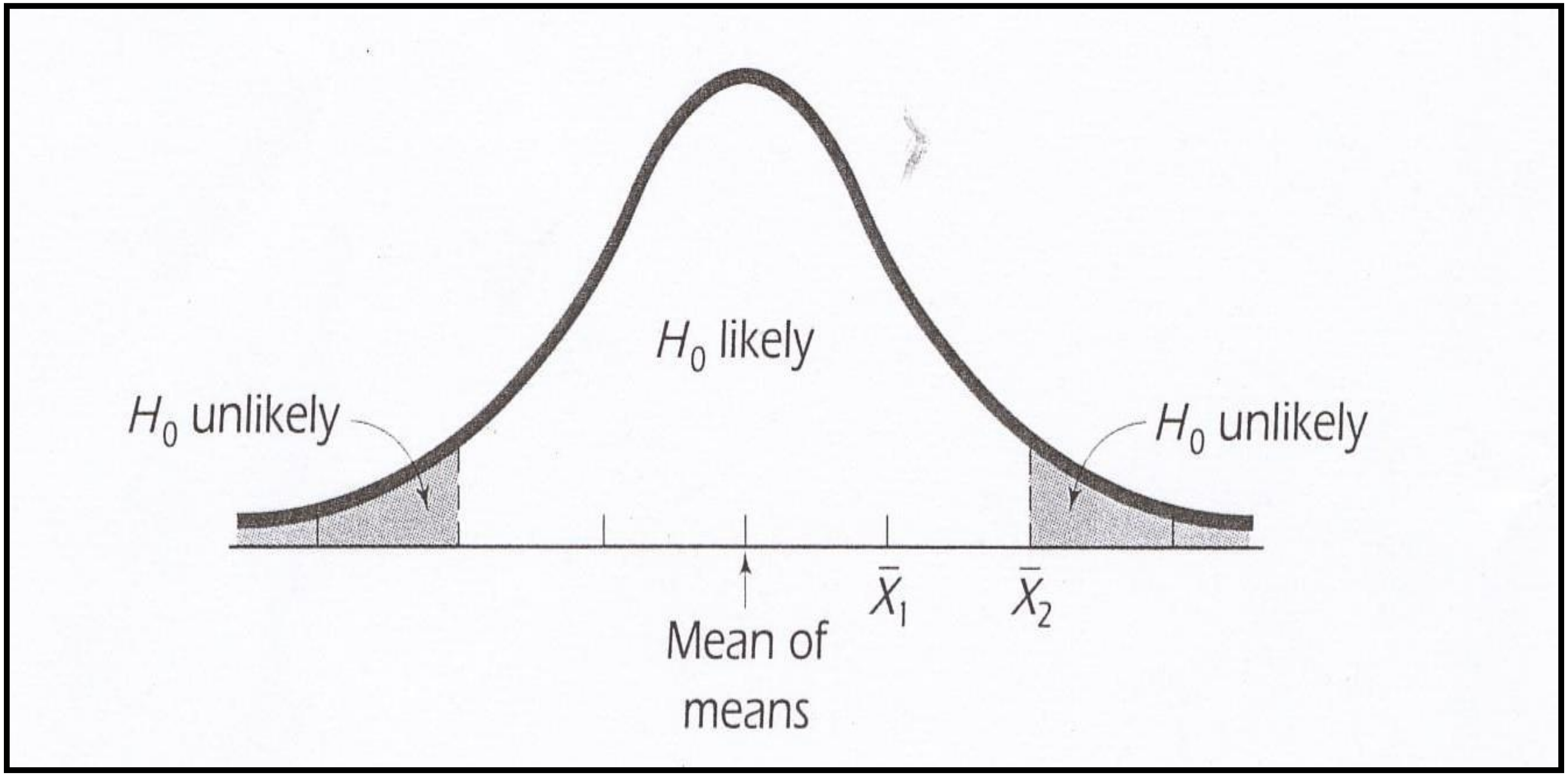
When the number of sample is large,
the distribution of sample means approaches a normal distribution (refer to Central Limit Theorem) i.e.




The distribution of sample means has a mean and standard deviation, denoted as

$$\mu_{\bar{X}} \quad \text{and} \quad \sigma_{\bar{X}}$$

# The Needs of $\mu_{\bar{X}}$ and $\sigma_{\bar{X}}$



# THE GENERAL IDEAS ABOUT *t* TESTS

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# The Central Limit Theorem

- ✓ The Central Limit Theorem states that any distribution of sample means approaches a normal distribution when the sample is infinitely large.
- ✓ Therefore, when a sample is large (more than 1000), it is appropriate to conduct a z test because the distribution of sample means approaches a normal distribution.
- ✓ However, when the sample is relatively small (less than 1000), the distribution of sample means is best matched by the *t* distribution.
- ✓ The central limit theorem provides the justification for using sample data run a z test.

# t Distribution

- ✓ The *t* distribution is similar to the *z* distribution in that both are symmetrical, bell-shaped sampling distributions.
- ✓ Major Difference:

  The overall shape of the *t* distribution is influenced strongly by the size of the samples used to generate it. For very large samples, the *t* distribution approaches the *z* distribution, but for smaller samples, the *t* distribution is flatter.

# Degree of Freedom (*df*)

- ✓ To find the critical value in this table for any particular *t*, you need know only what we call the "degrees of freedom" for your particular sample.
- ✓ Degrees of freedom (*df*) is a statistical term used to denote the number of scores within any distribution that are free to vary without restriction (see Vernoy & Vernoy p 264 – 265).
- ✓ The degrees of freedom *(df )* vary with different types of *t* tests;

| | |
|---|---|
| *df* = n – 1 | (single-sample *t* test) |
| *df* = $(n_1 - 1) + (n_2 - 1)$ | (independent-samples *t* test) |
| *df* = number of pairs – 1 | (paired-samples *t* test) |

# General Steps in Performing *t* Test

1. Fix the type of *t* test
2. Set $H_0$ and $H_1$
3. Find indices required to compute *t* score
4. Compute the *t* score
5. Find the degree of freedom
6. Find the $t_{critical}$
7. Draw a conclusion

Executable by SPSS

# Some Estimated Indices…..
(required to compute the *t* score)

$\text{est. } \sigma$ and $\text{est. } \sigma_{\overline{X}}$

$\sigma_{\text{diff}}$ and $\text{est. } \sigma_{\text{diff}}$