



Variables and Hypotheses

What is a Variable?

(A Characteristic or Attribute)

That can be

and

Measured

(Can be assessed
on an instrument
and recorded on
an instrument)

Varies

(Different values
or scores for
Different people)


Categorical and Continuous measures of variables


- ◆ A **categorical measure** is a value of a variable assigned by the researcher into a small number of categories. (e.g. Gender). (These variables do not vary in degree, amount or quantity).
- ◆ A **continuous measure** is the value of a variable assigned by the researcher to a point along a continuum of scores, from low to high. (e.g. Age). (These variables vary in degree, amount or quantity).



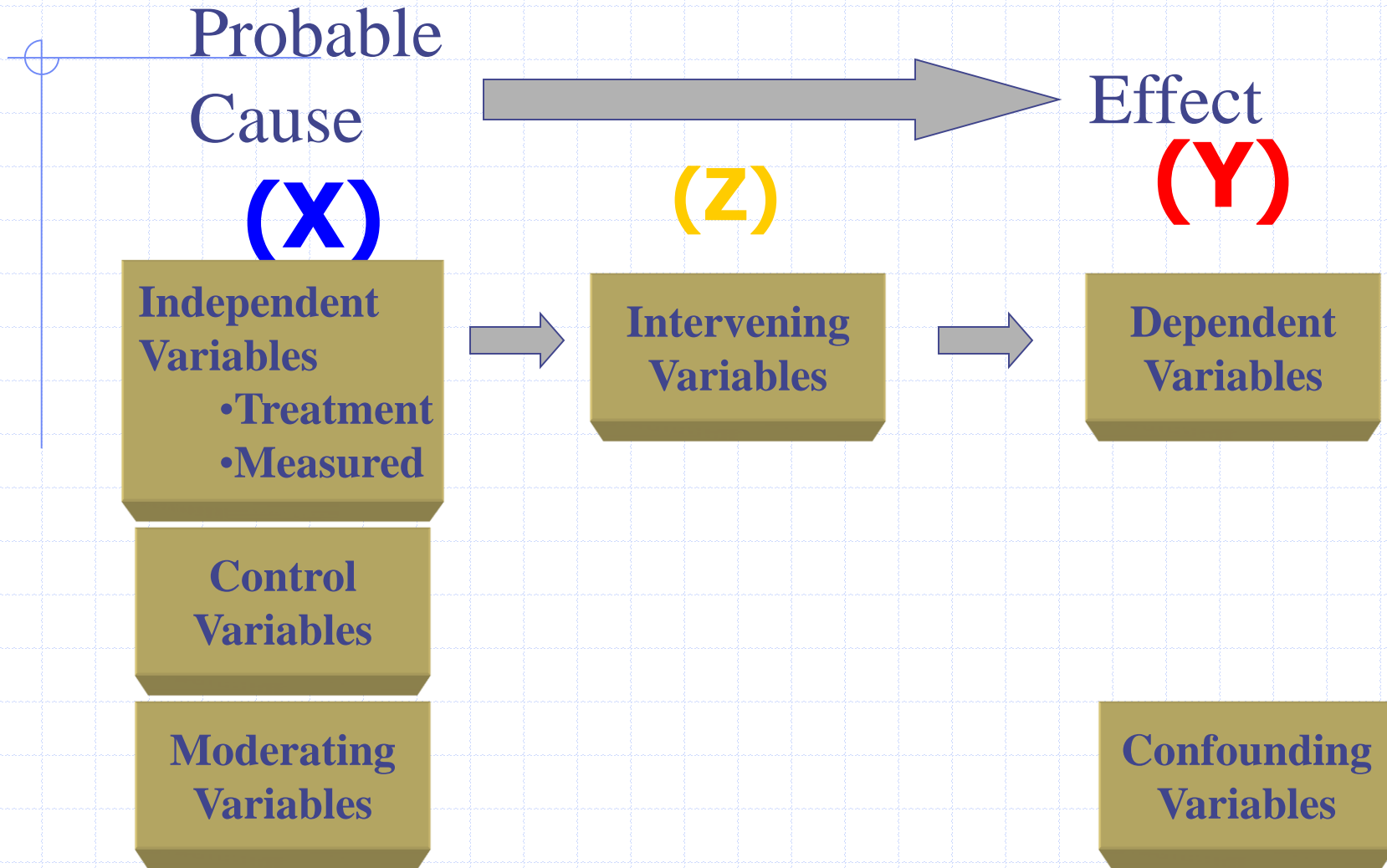
Variables and Constructs

- ◆ A Variable is an attribute or characteristic stated in a specific or applied way
- ◆ A Construct is an attribute or characteristic expressed in an abstract, general way.

Construct  **Student Achievement**

Variable  **Grade Point Average**

The Family of Variables in Quantitative Studies



Families of Variables

◆ **Dependent Variables:** An attribute or characteristic influenced by the independent variable. *Dependent variables are sometimes called: Outcome Variables*



Families of Variables

◆ **Independent Variable:** An attribute or characteristic that influences or effects an outcome or dependent variable. *Independent variables are sometimes called:*

- Treatment Variable
- Measured Variable
- Control Variable
- Moderating Variable
- **Experimental Variable**
- **Manipulated Variable**
- **Extraneous Variables**



Intervening Variables

- ◆ **Intervening Variables (Mediating Variables):**
An attribute or characteristic that “stands between” the dependent and independent variables.

Example of an Intervening Variable

Step 1

Independent Variable



Dependent Variable

Example Convenient office hours for students

Student seeks help from faculty

Step 2

Independent Variable



Intervening Variable

Example Convenient office hours for students

Student becomes willing to take risks

Step 3

Independent Variable



Intervening Variable



Dependent Variable

Example Convenient office hours for students

Student becomes willing to take risks

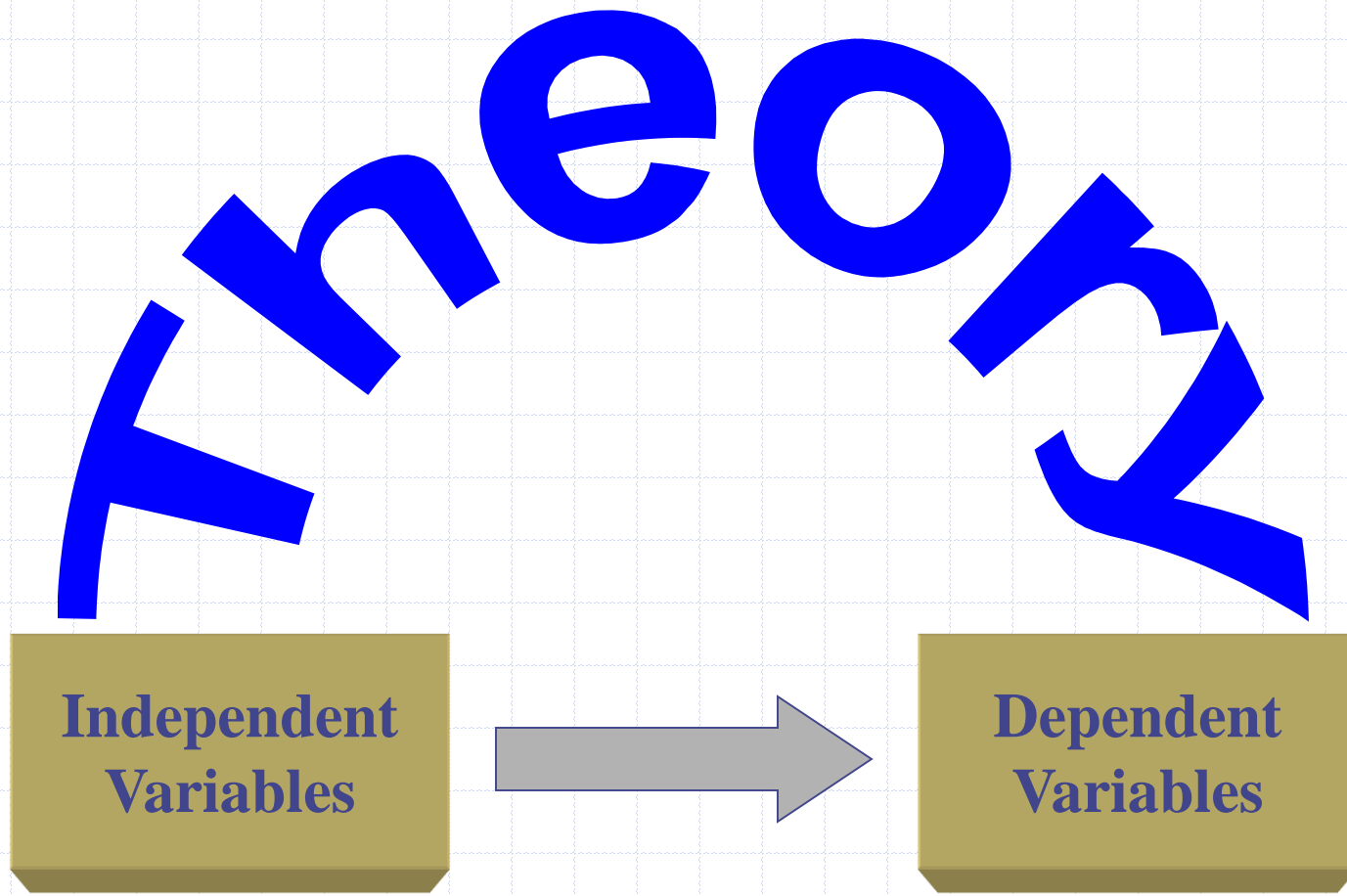
Student seeks help from faculty



Families of Variables

- ◆ **Confounding Variables (Spurious Variables):**
Attributes or characteristics that the researcher cannot directly measure because their effects cannot be easily separated from the other variables, even though they may influence the relationship between the independent and the dependent variable.

Theories as Bridges Between Independent and Dependent Variables



What is a Hypothesis?

- ◆ A hypothesis is a prediction regarding the possible outcome of a study.
- ◆ Advantages of stating hypotheses include:
 - ◆ Forces us to think more deeply and specifically about the possible outcomes of the study
 - ◆ Enables us to make specific predictions based on prior evidence or theoretical argument
 - ◆ Helps to clarify if we are investigating a relationship
- ◆ Disadvantages of stating hypotheses include:
 - ◆ May lead to a bias on the Chapter of the researcher
 - ◆ In some studies, it would be presumptuous to predict what findings would be
 - ◆ Focusing on the hypothesis could prevent the researcher from seeing other phenomena that might be important to the study



Research Hypotheses

◆ Three types:

- Null hypothesis *(specifies that there is no relationship in the population)*
- Directional alternative hypothesis *(indicates the specific direction that a researcher expects to emerge in a relationship)*
- Non-directional alternative hypothesis. *(there is no specific prediction about what direction the outcome of a study will take)*

Directional vs. Non-directional Hypotheses

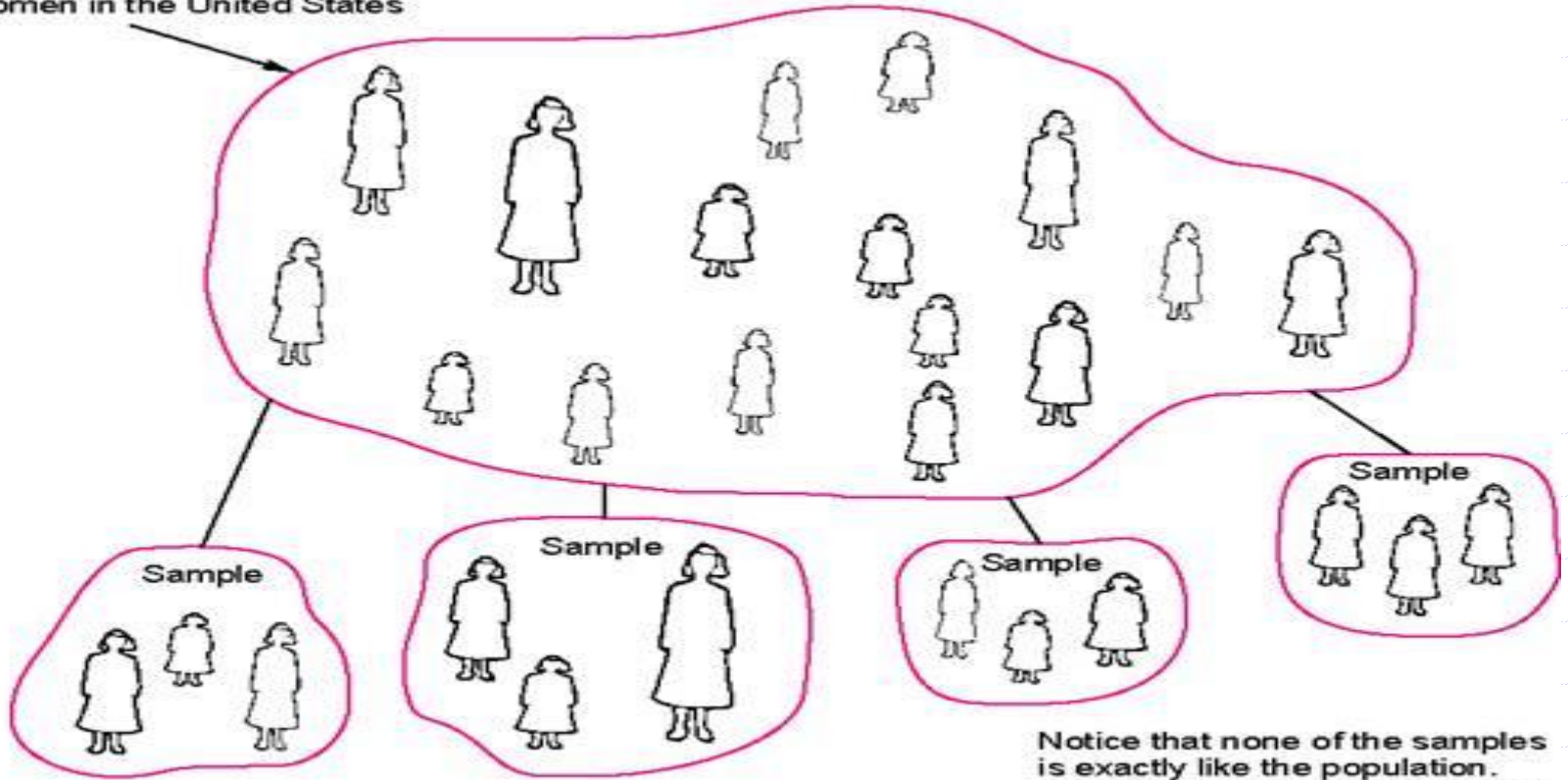
- ◆ A **directional hypothesis** is one in which the researcher indicates the specific direction that he or she expects will emerge in a relationship in the study.
 - The direction is based on what the researcher has found from:
 - ◆ Literature
 - ◆ Personal experiences
 - ◆ Experience from others

- ◆ A non-directional hypothesis is when there is no specific prediction about what direction the outcome of a study will take.
 - Sometimes it is difficult to make specific predictions upon a study
 - ◆ A study may state that it would point to non-specific directions vs. distinct possibilities



Sampling Error

Population of 100 adult women in the United States



Notice that none of the samples is exactly like the population. This difference is what is known as sampling error.

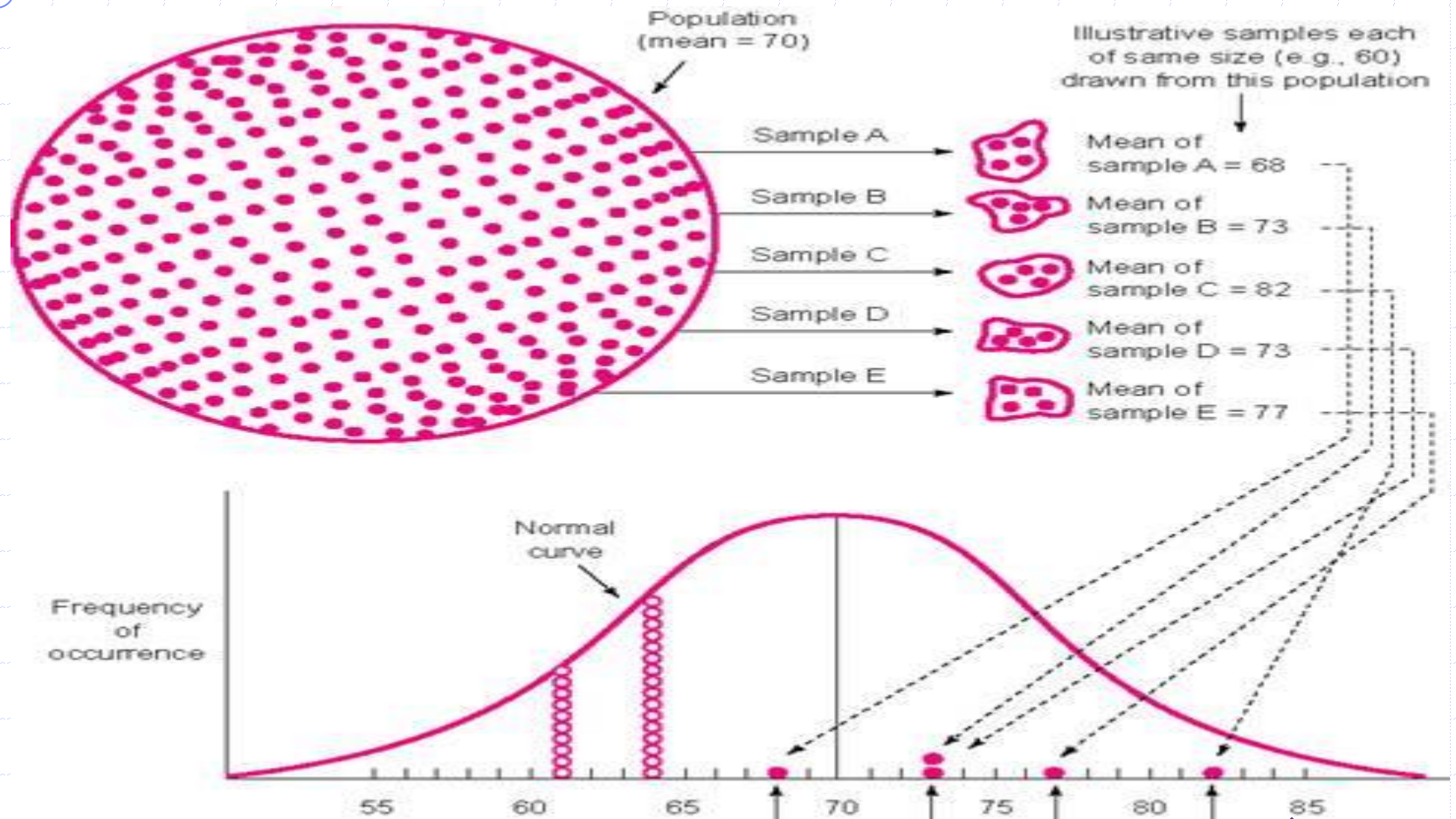
Distribution of Sample Means

- ◆ There are times where large collections of random samples do pattern themselves in ways that will allow researchers to predict accurately some characteristics of the population from which the sample was taken.
- ◆ A sampling distribution of means is a frequency distribution resulting from plotting the means of a very large number of samples from the same population

Refer to Figure 11.3



A Sampling Distribution of Means



Standard Error of the Mean

- ◆ The standard deviation of a sampling distribution of means is called the Standard Error of the Mean (SEM).
- ◆ If you can accurately estimate the mean and the standard deviation of the sampling distribution, you can determine whether it is likely or not that a particular sample mean could be obtained from the population.
- ◆ To estimate the SEM, divide the SD of the sample by the square root of the sample size minus one.

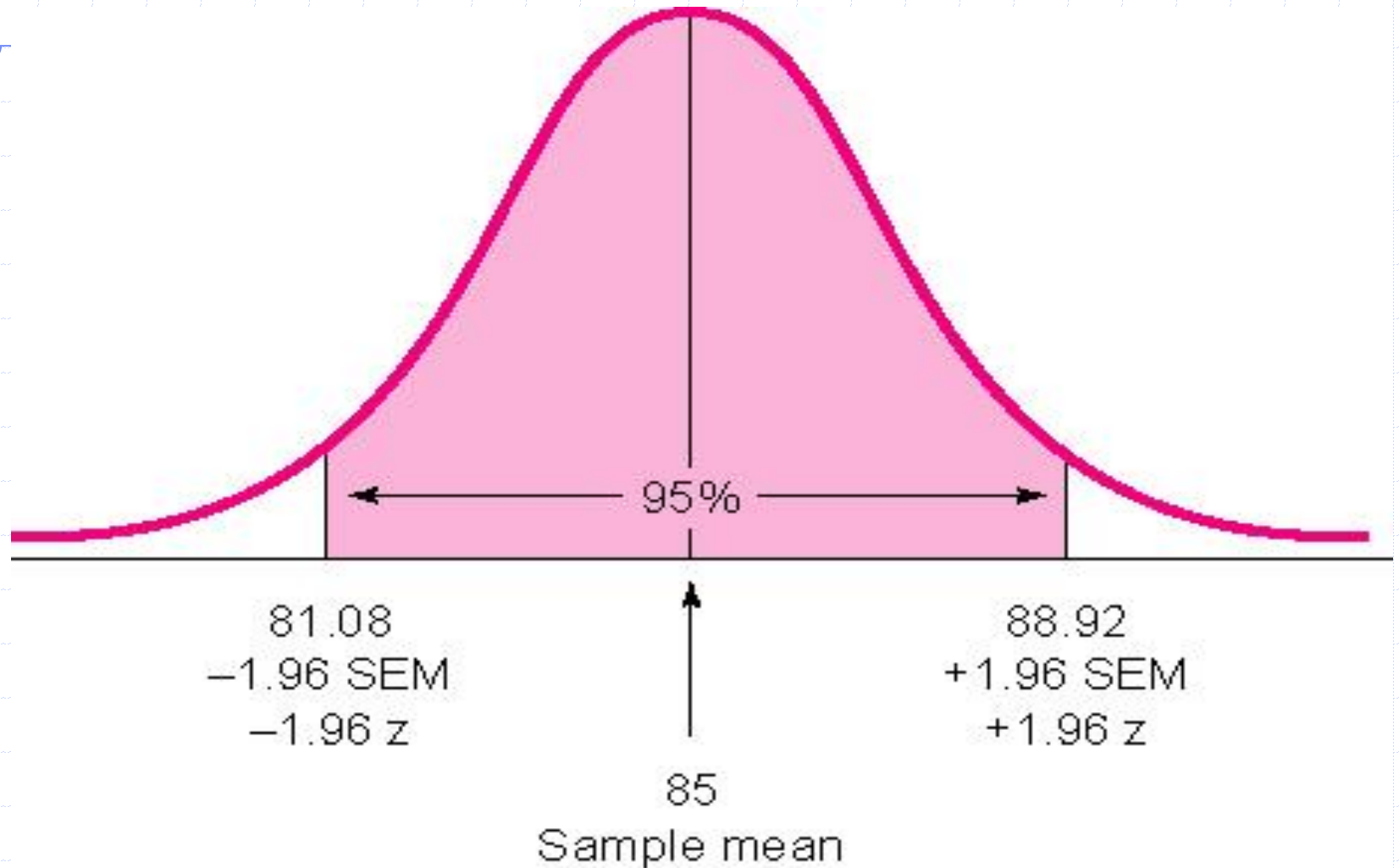
Refer to Figure 11.4



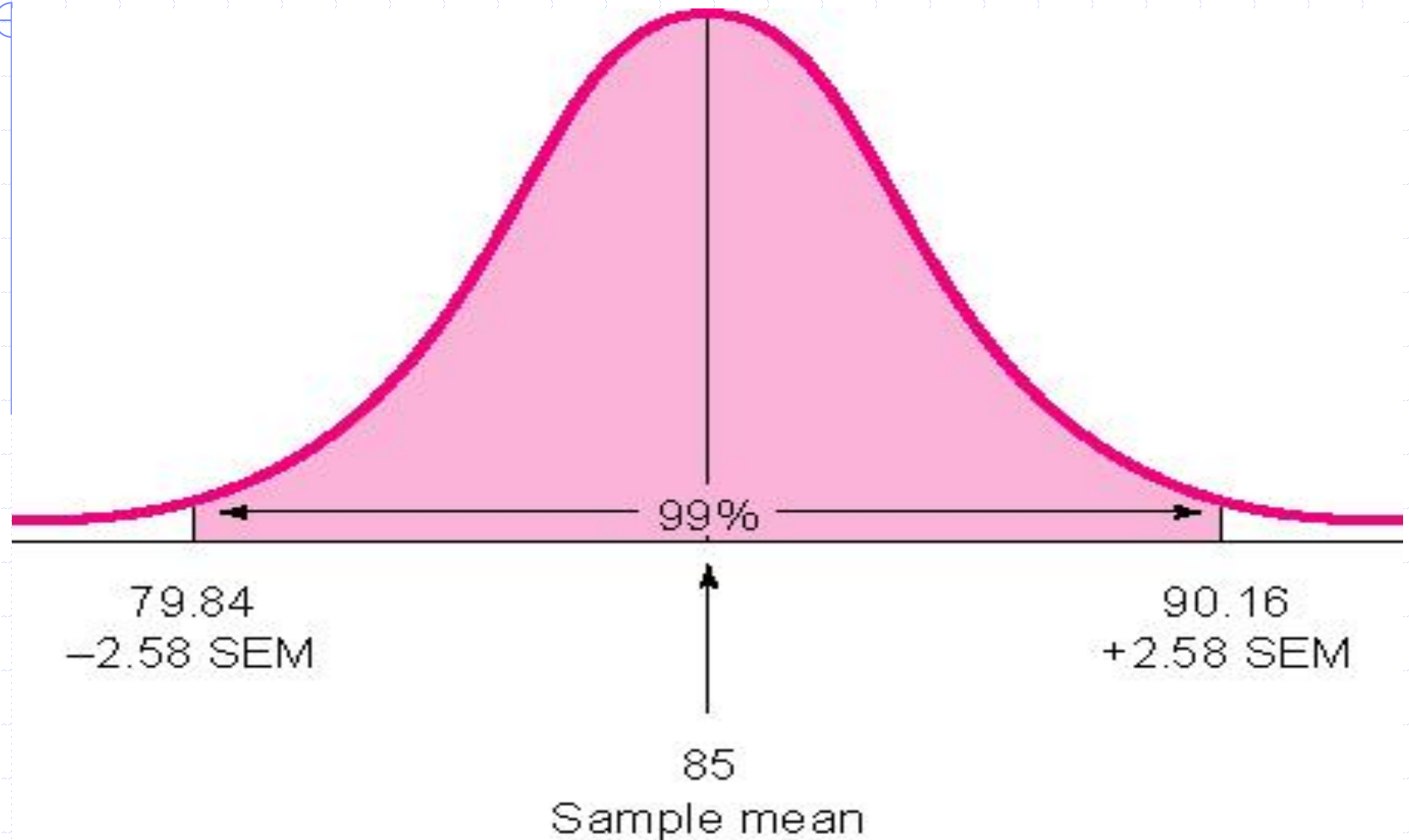
Confidence Intervals

- ◆ A Confidence Interval is a region extending both above and below a sample statistic within which a population parameter may be said to fall with a specified probability of being wrong.
- ◆ SEM's can be used to determine boundaries or limits, within which the population mean lies.
- ◆ If a confidence interval is 95%, there would be a 'probability' that 5 out of 100 (population mean) would fall outside the boundaries or limits.

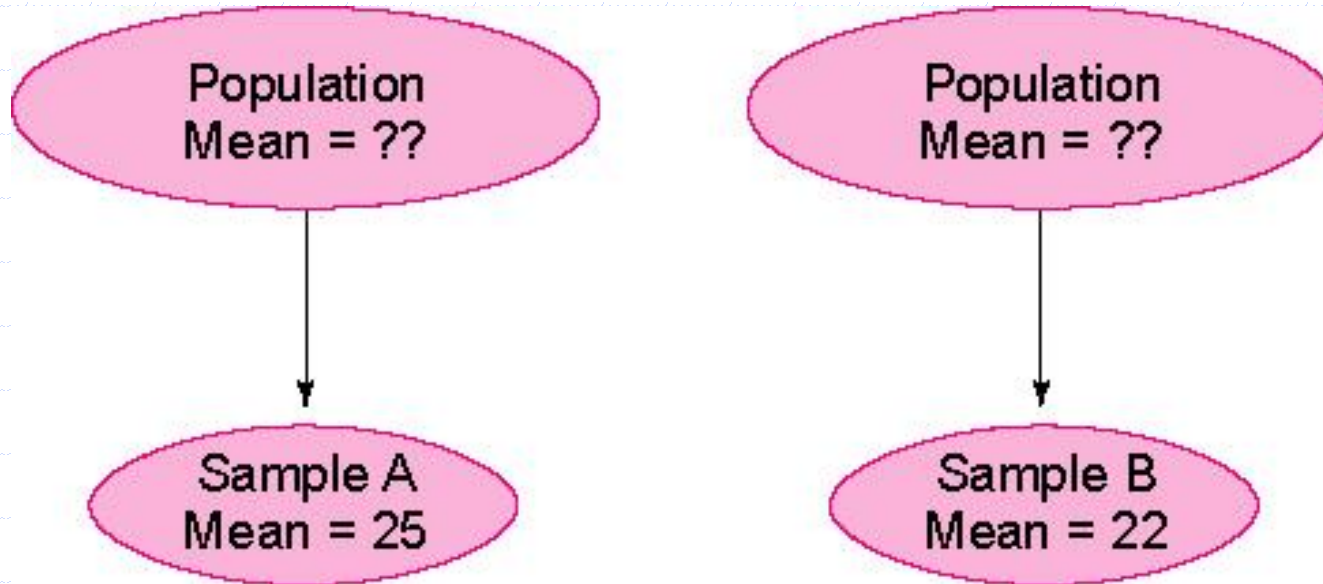
The 95 percent Confidence Interval



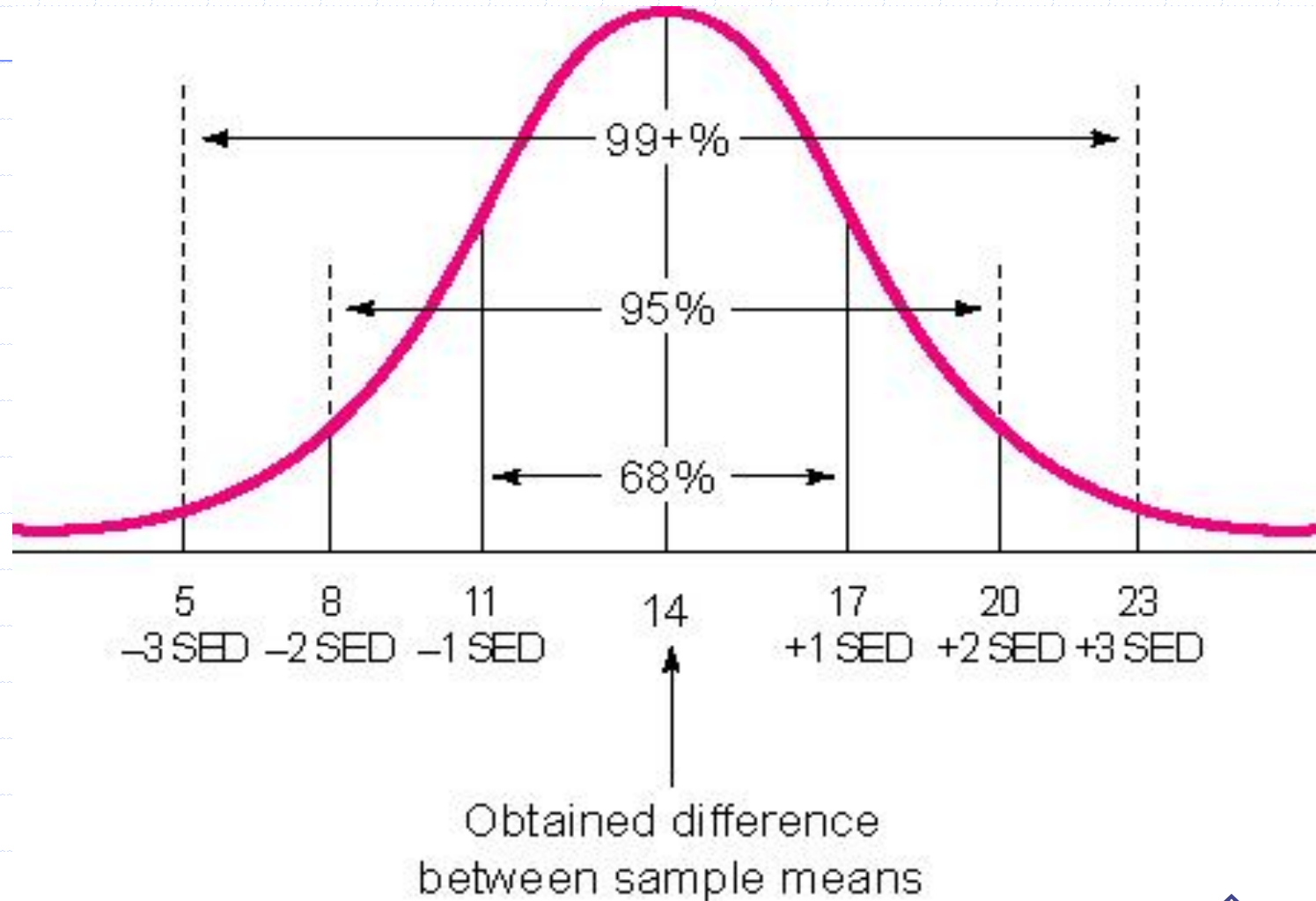
The 99 percent Confidence Interval



Does a Sample Difference Reflect a Population Difference?



Confidence Intervals



What are Inferential Statistics?

- ◆ **Inferential Statistics** refer to certain procedures that allow researchers to make inferences about a population based on data obtained from a sample.
- ◆ Obtaining a random sample is desirable since it ensures that this sample is representative of a larger population.
- ◆ The better a sample represents a population, the more researchers will be able to make inferences.
- ◆ Making inferences about populations is what Inferential Statistics are all about.

Hypothesis Testing

- ◆ Hypothesis testing is a way of determining the probability that an obtained sample statistic will occur, given a hypothetical population parameter.
- ◆ The Research Hypothesis specifies the predicted outcome of a study.
- ◆ The Null Hypothesis typically specifies that there is no relationship in the population.

Hypothesis Testing: A Review

- ◆ State the research hypothesis
- ◆ State the null hypothesis
- ◆ Determine the sample statistics pertinent to the hypothesis
- ◆ Determine the probability of obtaining the sample results
- ◆ If the probability is small, reject the null hypothesis and affirm the research hypothesis
- ◆ If the probability is large, do not reject the null hypothesis and do not affirm the research hypothesis

Practical vs. Statistical Significance

- ◆ The terms “significance level” or “level of significance” refers to the probability of a sample statistic occurring as a result of sampling error.
- ◆ Significance levels most commonly used in educational research are the .05 and .01 levels.
- ◆ Statistical significance and practical significance are not necessarily the same since a result of statistical significance does not mean that it is practically significant in an educational sense.