

Chapter 1	Introduction to Statistics
Section 4	Design of Experiments

## Guidelines for Planning a Study

- Identify the population.
- Decide what measurements/observations to make, and the rules for making them.
- Determine whether to use the entire population (census) or a representative sample.
- Plan how the data will be collected.
- Collect the data.
- Analyze the data, then describe the data and make decisions.
- Note any concerns/problems and make recommendations for future studies.

## Types of Studies

Observational: The population is observed and measured with no attempt at change.

Cross-Sectional: Data observed, measured, and collected one point in time.

Retrospective (Case-Control): Data collected over a past period of time.

Prospective (Longitudinal, cohort): Data collected over a future period of time.

Experimental: A treatment is imposed on the population to affect a change.

## Clinical Study or Clinical Trial

The goal of a clinical study is to isolate the single variable under investigation.

Does a single variable or treatment (vaccine, drug, therapy, etc) cause a certain effect (disease, symptom, cure, etc)?

## Confounding Variable

A variable that might cause the same effect (disease, symptom, cure, etc) as the variable under investigation.

## Controlled Study

### Blinding

Blind Study – The subjects in both groups do not know whether they are receiving the treatment or the placebo.

Double-Blind Study – The scientists conducting the experiment do not know which group is receiving the treatment and which is receiving the placebo. The knowledge on the part of the scientists can cause a bias or cause a reaction in the subjects because of expectation on the part of the scientist.

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## Controlled Study (cont)

### Blocks

Forming groups of subjects with similar characteristics. These blocks can be formed in two ways:

1. Completely Randomized Experimental Design – Subjects are placed in blocks by random selection.
2. Rigorously Controlled Design – Subjects are carefully chosen.

Treatment Group: those subjects receiving the treatment

Control Group: those subjects not receiving the treatment, but may receive a placebo instead. A placebo is an inert or innocuous substance given in place of a drug.

Placebo Effect: Just the idea that one is receiving treatment, even if it is a placebo, can produce positive results. Mind over matter.

### Random Sample

A random sample is one in which every member in the population has an equal chance of being selected.

### Simple Random Sample

A simple random sample is one in which every possible sample of the same size has an equal chance of being selected.

### Methods of Sampling

Stratified: Dividing the population into groups – age, income, education level, etc. Random samples are then drawn from each group.

Systematic: Members of the population are sequentially numbered, then every  $k$ th member is included in the population.

Cluster: Dividing the population into groups, usually geographic location. All members of a randomly selected cluster are included in the sample.

Convenience: Readily available members of the population are included in the sample. The marketing people you see in the mall conducting surveys.

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### Sampling Error

The difference between a sample result and the true population.

### Non-Sampling Error

The data is incorrectly collected, recorded, or analyzed.