

Laugh at your mistakes;  
But learn from them.

Joke over your troubles;  
But gather strength from them.

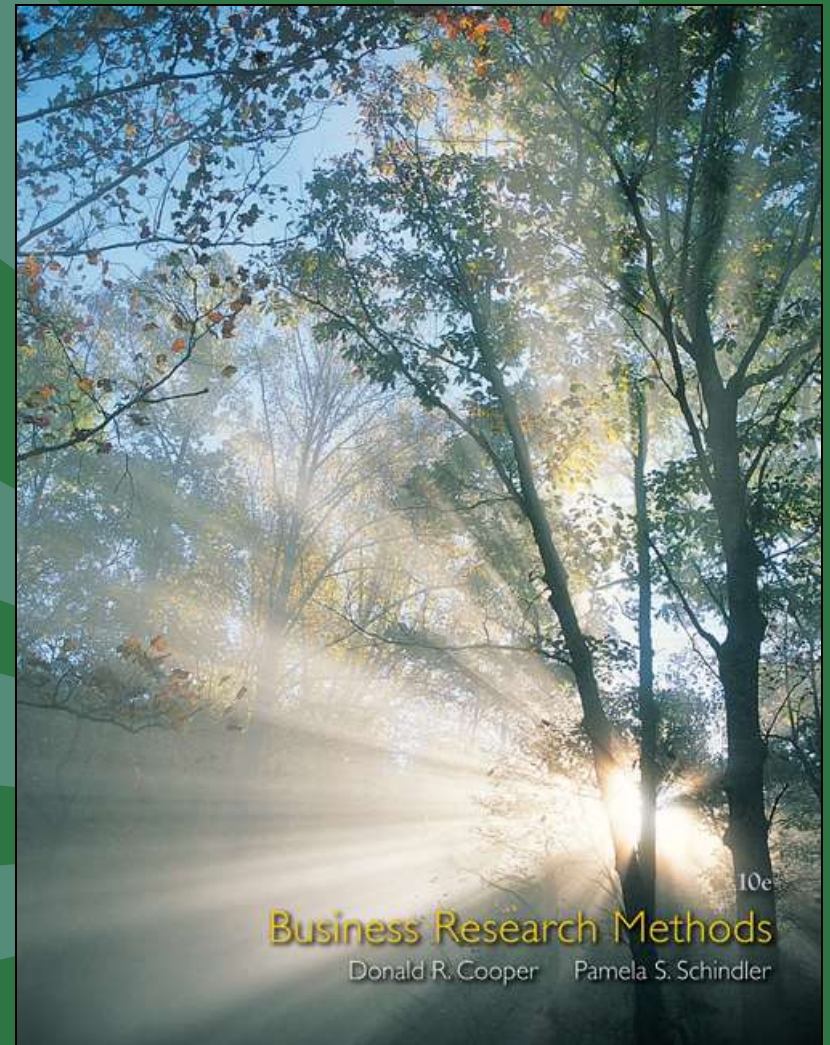
Have fun with your difficulties;  
But overcome them.

These are Lessons of Life for you!!



  
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# Sampling



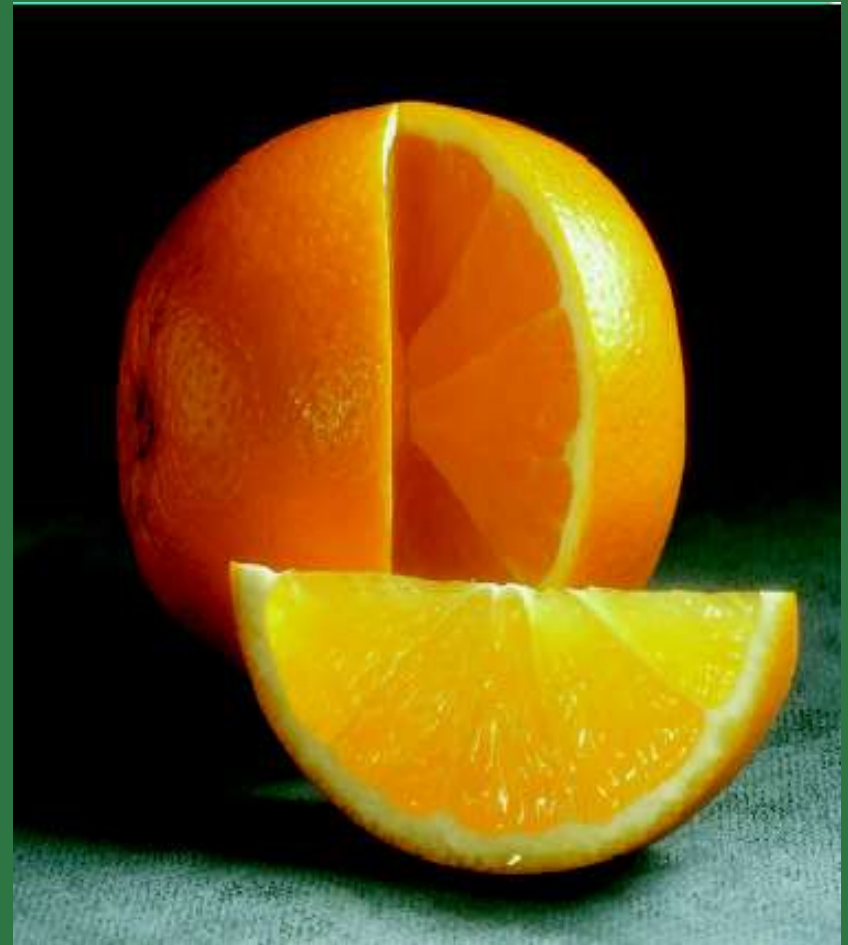
# Learning Objectives

## Understand . . .

- The two premises on which sampling theory is based.
- The accuracy and precision for measuring sample validity.
- The five questions that must be answered to develop a sampling plan.
- The two categories of sampling techniques and the variety of sampling techniques within each category.
- The various sampling techniques and when each is used.

# Idea of Sampling

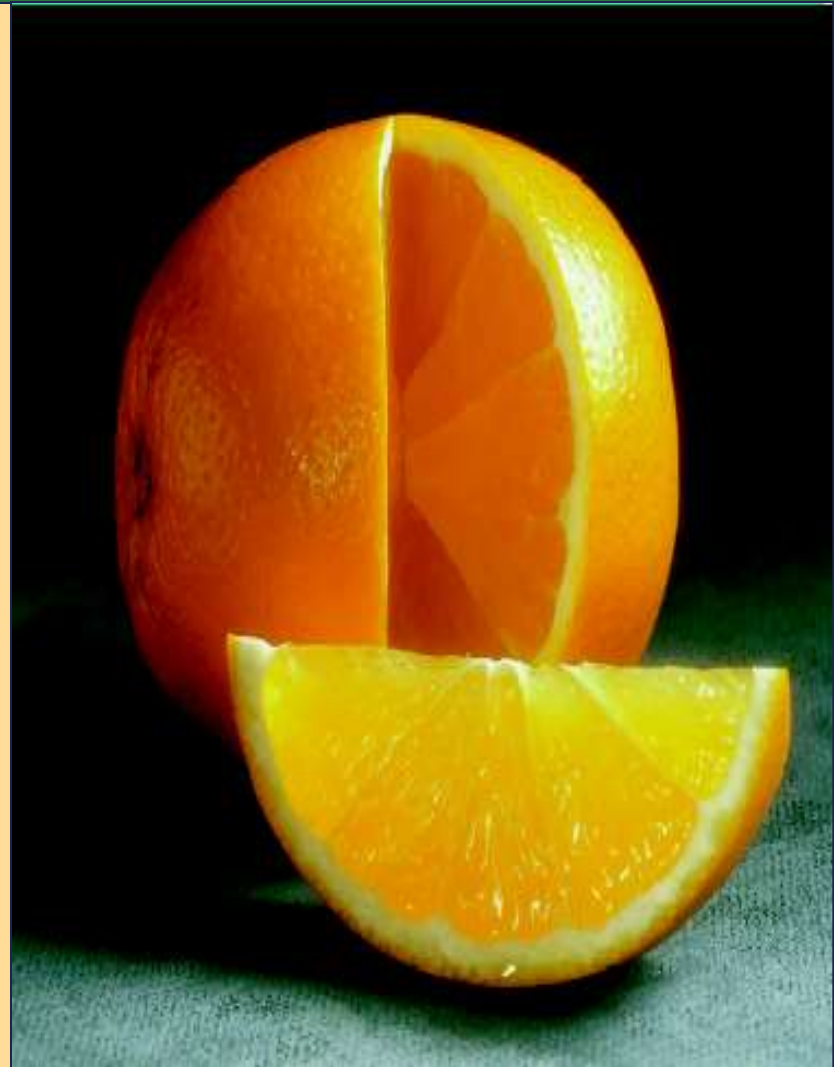
The basic idea of sampling is that **by selecting several elements** from a population, we can make an **inference** about the **entire population**.





# The Nature of Sampling

- Population
- Population Element
- Sample
- Sample subject
- Sampling frame
- Census
- Parameter
- Statistics



# Inference Process

Estimation &  
Hypothesis  
Testing



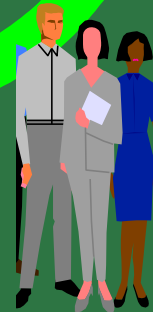
Population



Sample  
Statistics  
 $(\bar{X}, p_s)$



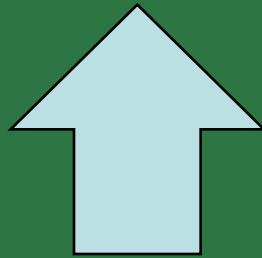
Sample



# Parameter and Statistics: Example

*“Average height of 2<sup>nd</sup> year students is 150 centimeters”*

Parameter



*“Average height of 2nd year students in Mr Ali’s class is 150 centimeters”*

Statistic



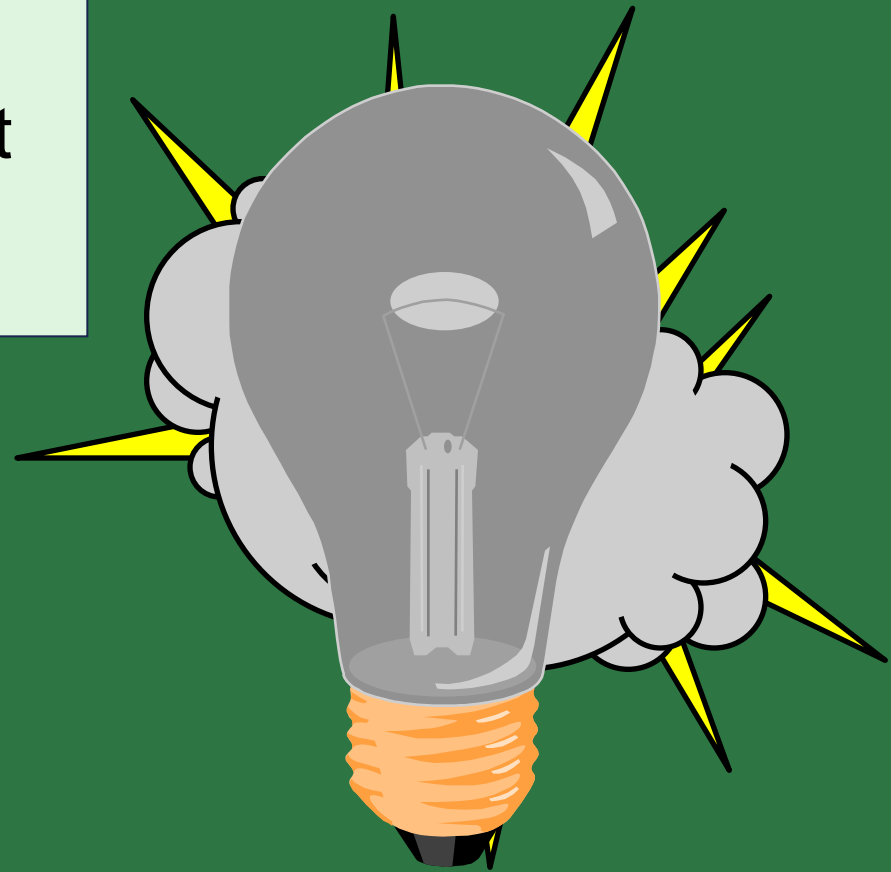
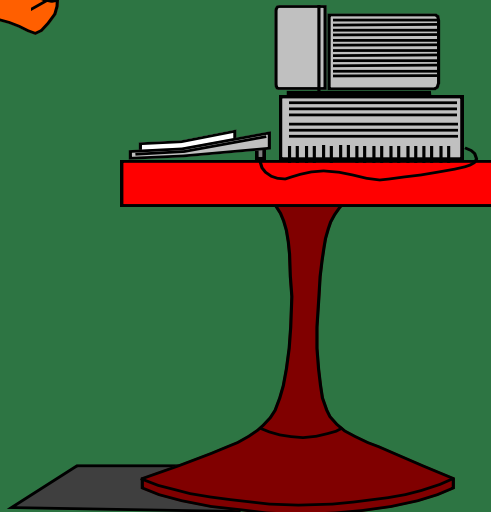
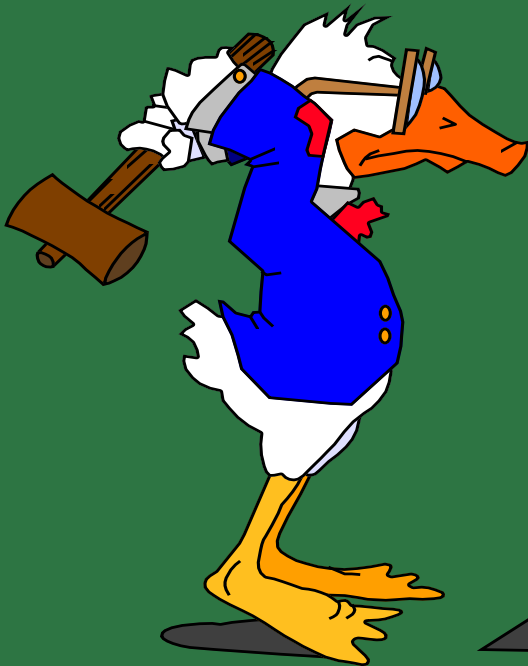
Population



Sample

# Why Sampling is Needed?

- Cost
- Time
- Destruction of Test unit
- More accurate





# When Is a Census Appropriate?



Feasible

Necessary

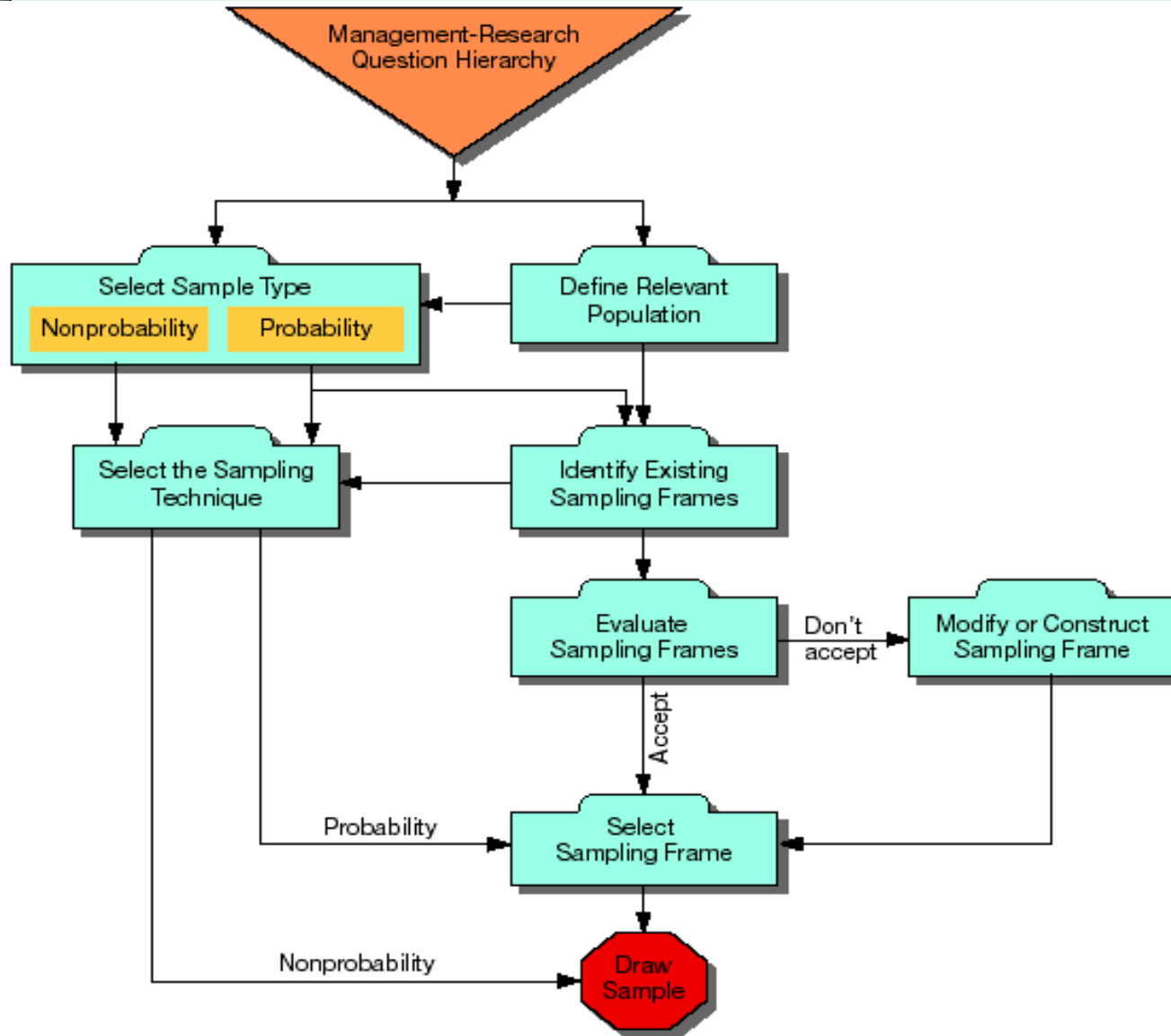
# What Is a Valid Sample?

Accurate



Precise

# Sampling Design within the Research Process



# Types of Sampling Designs

Element Selection	Probability	Nonprobability
Unrestricted	Simple random	Convenience
Restricted	Complex random	Purposive
	Systematic	Judgment
	Cluster	Quota
	Stratified	Snowball
	Double	

# Some basic terms

- Representativeness
- Probability Sampling
  - Randomly selected, each element has a known probability of being chosen which is not equal to 0
- Non Probability Sampling
  - Non random, unknown probability of being chosen

# Steps in Sampling Design



What is the target population?

What are the parameters of interest?

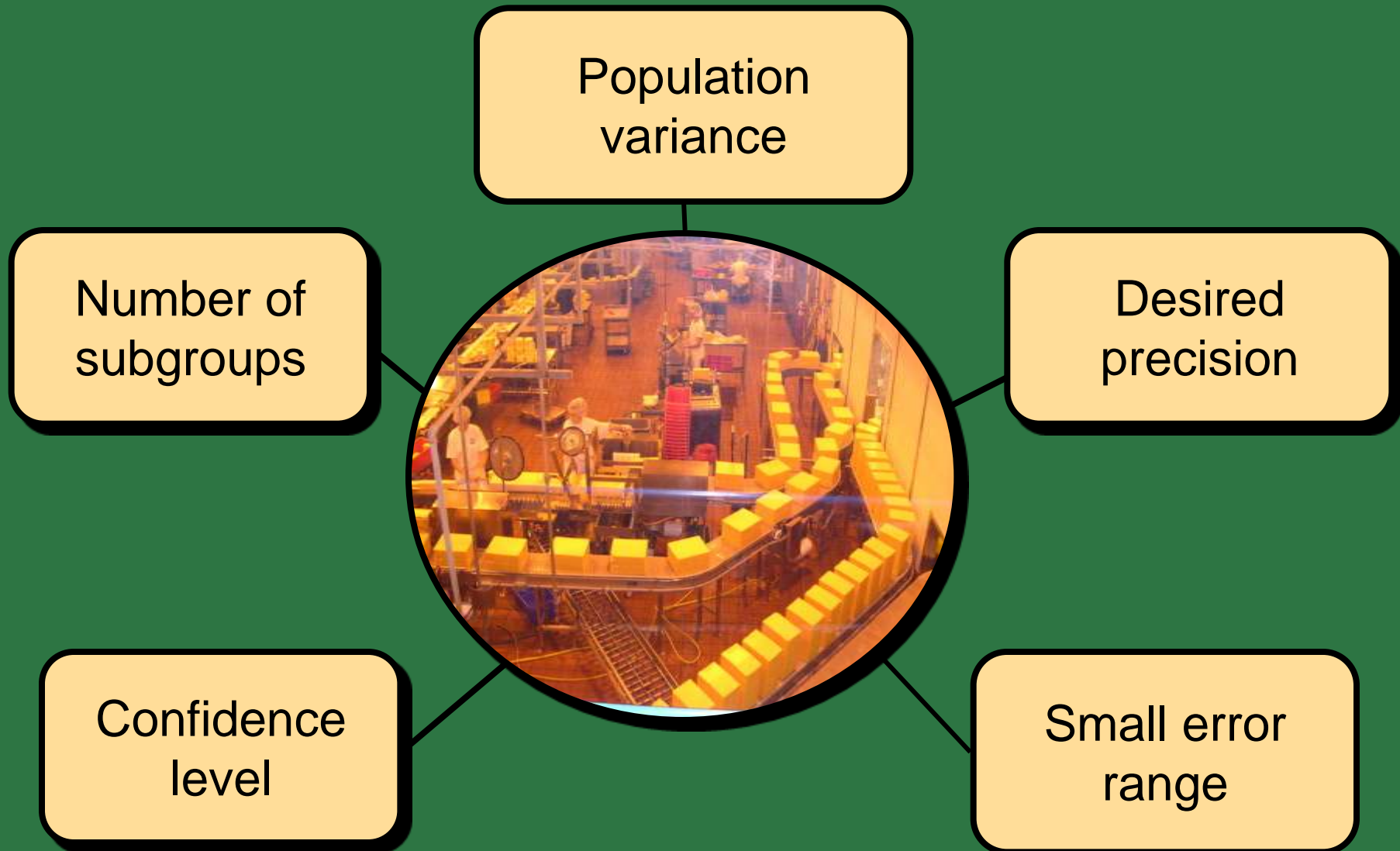
What is the sampling frame?

What is the appropriate sampling method?

What size sample is needed?



# When to Use Larger Sample Sizes?



# Selecting a random sample

- Numbered paper/ball
- Random number tables
- Computer generated



# Simple Random

## Advantages

- Easy to implement with random dialing

## Disadvantages

- Requires list of population elements
- Time consuming
- Uses larger sample sizes
- Produces larger errors
- High cost



# Systematic

## Advantages

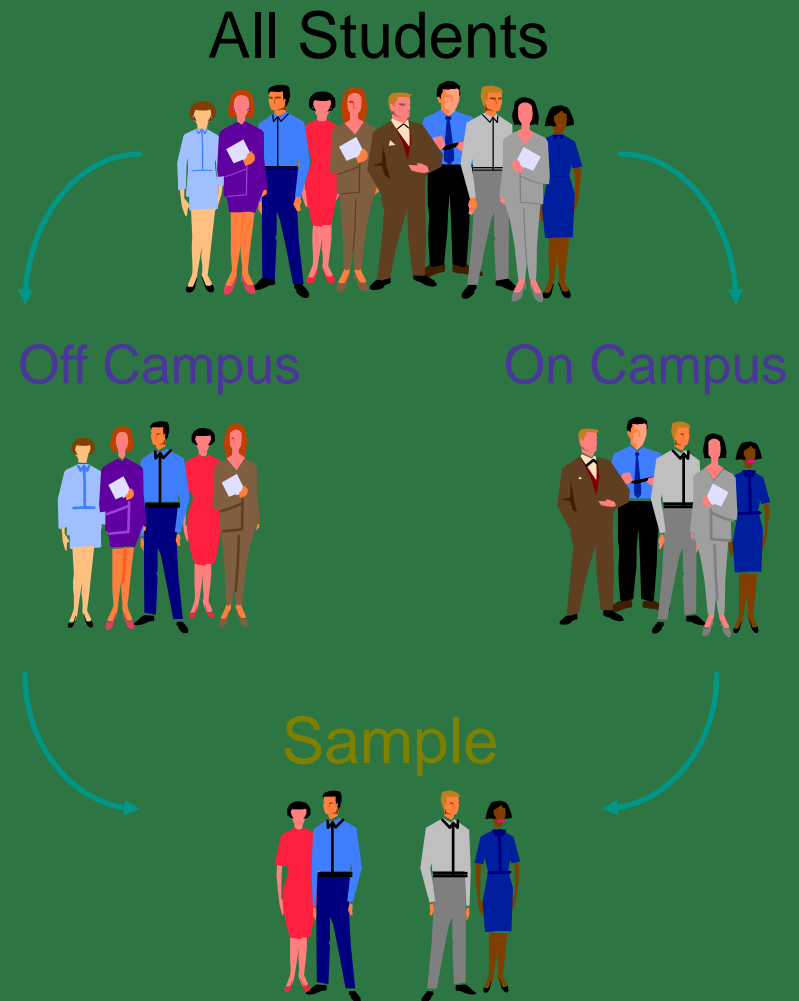
- Simple to design
- Easier than simple random
- Easy to determine sampling distribution of mean or proportion

## Disadvantages

- Periodicity within population may skew sample and results
- Trends in list may bias results
- Moderate cost

# Stratified Sampling

- Population is divided into sub-population or stratum and the subjects selected randomly.
  - Proportionate.
  - Disproportionate





# Stratified

## Advantages

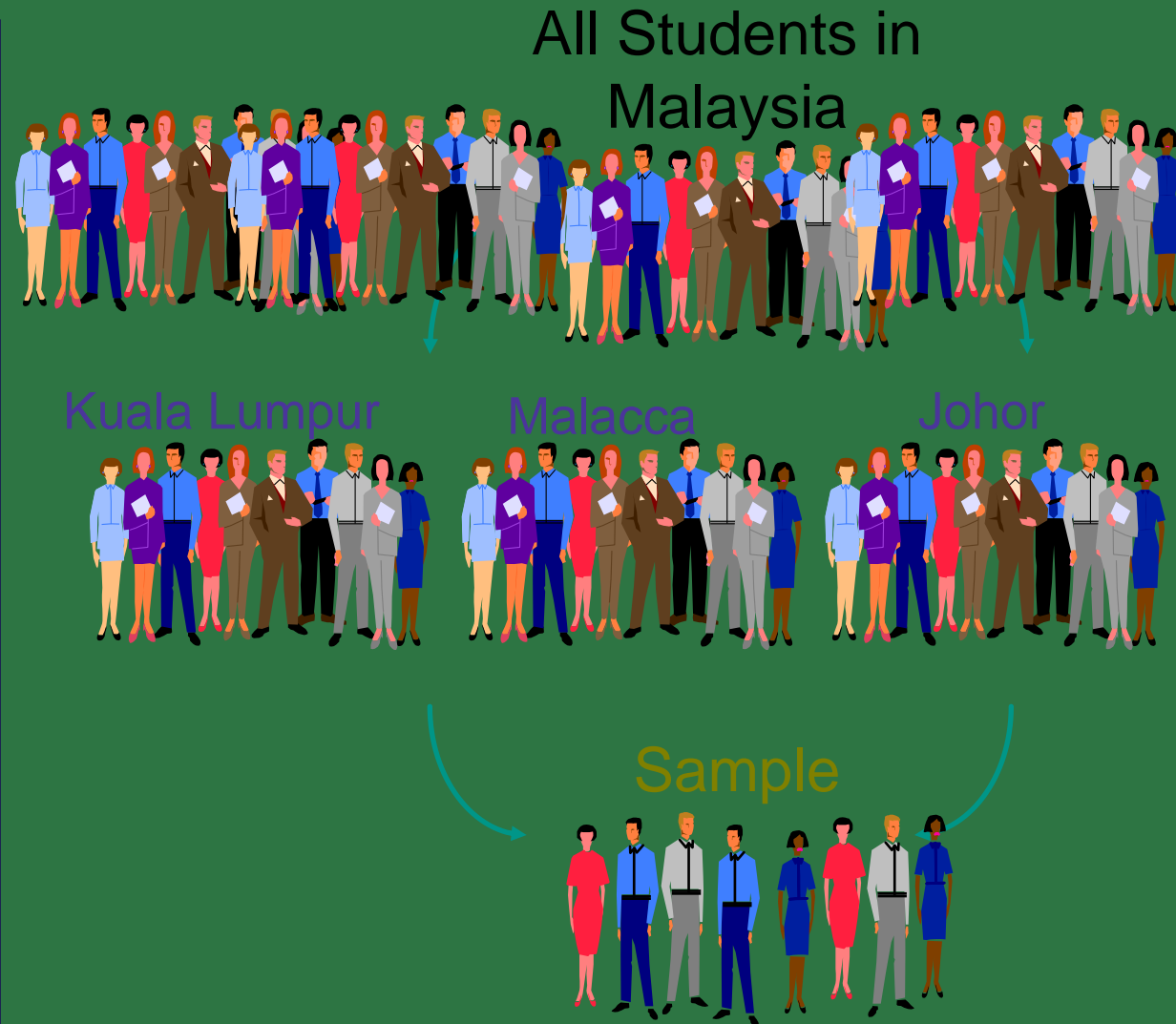
- Control of sample size in strata
- Increased statistical efficiency
- Provides data to represent and analyze subgroups
- Enables use of different methods in strata

## Disadvantages

- Increased error will result if subgroups are selected at different rates
- Especially expensive if strata on population must be created
- High cost

# Clustered Sampling

- Population is divided into clusters, the cluster is randomly selected



# Cluster

## Advantages

- Provides an unbiased estimate of population parameters if properly done
- Economically more efficient than simple random
- Lowest cost per sample
- Easy to do without list

## Disadvantages

- Often lower statistical efficiency due to subgroups being homogeneous rather than heterogeneous
- Moderate cost

# Stratified and Cluster Sampling

## Stratified

- Population divided into few subgroups
- Homogeneity within subgroups
- Heterogeneity between subgroups
- Choice of elements from within each subgroup

## Cluster

- Population divided into many subgroups
- Heterogeneity within subgroups
- Homogeneity between subgroups
- Random choice of subgroups

# Area Sampling



# Double Sampling

## Advantages

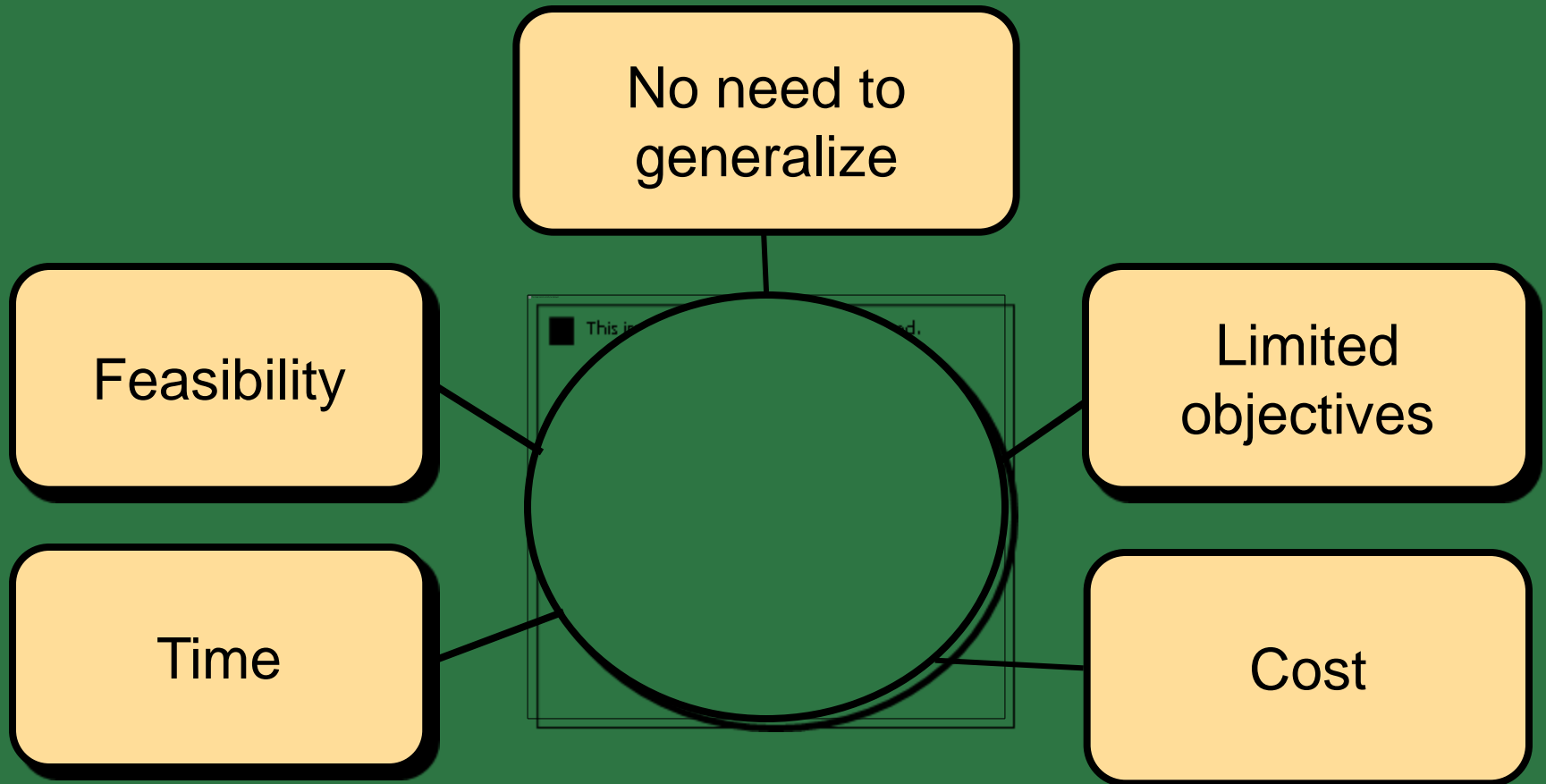
- May reduce costs if first stage results in enough data to stratify or cluster the population

## Disadvantages

- Increased costs if indiscriminately used



# Nonprobability Samples



# Nonprobability Sampling Methods



Convenience

Judgment

Quota

Snowball



# What is Important in this chapter?

- Basic terms
- Why sampling is needed?
- Characteristics of a good sample
- Probability and non probability samples
- When each should be used

# Exercise 1

- A medical inspector desires to estimate the overall average monthly occupancy rates of the cancer wards in eighty different hospitals that are evenly located in the northwestern, southeastern, central, and southern suburbs of New York City.

# Exercise 2

- Carbondale is a university town with about 24,000 students – a number of whom come from various parts of the world. For instance, there are about 200 Indian and 600 Malaysian students – about half of each category being women – and a further 1000 students attend Southern Illinois University at Carbondale coming from over 55 other countries.
- Martha Ellenden, a talented and adventurous seamstress, desires to open a tailoring shop (so rare these days!) in Carbondale, close to the University Mall, where she lives. She has a good sewing machine and would start her business immediately if she knew there was a demand for her services. To assess the market potential, Martha would like to talk to a few women to estimate how many clients she might attract. While the American women buy ready-made clothes from the University Mall, she knows that the international women, particularly the Indians and the Malaysians, buy plain material from the Mall and either stitch their own blouses or send them to their native homes to have them stitched. Martha would like to talk to forty-five or so individuals to estimate what demand might exist. How would Martha go about selecting the forty-five individuals?

## Exercise 3

- The Director of University Women's Professional Advancement (UWPA), appointed by the President of SIUC to enhance the status of women on campus some two years ago, was listening to a speech made by the President of the Women's Caucus. It suddenly occurred to the Director that it would be a great idea to get the opinion of members of this vocal group on how effective they perceived UWPA to be in enhancing the status of women on campus. She thought she could ask a few quick questions as the audience left the meeting room. What should be her sampling design and how should she proceed?



## Exercise 4

- A consultant has administered a questionnaire to some 285 employees using a simple random sampling procedure. As he looked at the responses, he felt that two of the items in the questionnaire might not have been clear to the respondents. He would like to know if this true.

# Exercise 5

- The McArthur Company produces special vacuum cleaners that can be conveniently used to clean the inside of cars. About a thousand of these are produced every month with serial numbers attached to them and stored serially in a stock room. Once a month an inspector comes and does a quality control check on fifty of the units. When he certifies them to be of a acceptable quality, the units are released form the stock room for sale. The production and sales managers, however, are not satisfied with the quality control check since, quite often, many of the units sold are returned by customers for various types of defects. What would be the most useful sampling plan to test the fifty units?