

# Chapter 7 - Sampling and Sampling Distributions

## Chapter 7 - Sampling

An **element** is the entity on which data are collected.

A **population** is the set of all the elements of interest.

A **sample** is a subset of the population.

A **frame** is a list of the elements that the sample will be selected from.

The reason we select a sample is to collect data to answer a research question about a population.

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## Introduction

The sample results provide **only estimates** of the values of the population characteristics.

The reason is simply that the sample contains **only a portion** of the population.

With **proper sampling methods**, the sample results can provide “good” estimates of the population characteristics.

This chapter provides the basis for determining how large the estimation error might be.

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## Sampling from a Finite Population

- **Finite populations** are often defined by lists such as:
  - Organization membership roster
  - Credit card account numbers
  - Inventory product numbers
- A **simple random sample** of size  $n$  from a finite population of size  $N$  is a sample selected such that each possible sample of size  $n$  has the same probability of being selected.
- Replacing each sampled element before selecting subsequent elements is called **sampling with replacement**.
- **Sampling without replacement** is the procedure used most often.
- In large sampling projects, computer-generated **random numbers** are often used to automate the sample selection process.

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## Sampling from a Finite Population Using Excel

### ■ Example: St. Andrew's College

St. Andrew's College received 900 applications for admission in the upcoming year from prospective students. The applicants were numbered, from 1 to 900, as their applications arrived. The Director of Admissions would like to select a **simple random sample** of 30 applicants.

**Step 1:** Assign a random number to each of the 900 applicants.

The random numbers generated by Excel's **RAND** function follow a uniform probability distribution between 0 and 1.

**Step 2:** Select the 30 applicants corresponding to the 30 smallest random numbers.

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# Chapter 7 - Sampling and Sampling Distributions

## Sampling from a Finite Population Using Excel

- Excel Value Worksheet
- Use Rand to assign random number to observation

	A	B		A	B
1	Applicant Number	Random Number	1	Applicant Number	Random Number
2	1	=RAND()	2	1	0.61021
3	2	=RAND()	3	2	0.83762
4	3	=RAND()	4	3	0.58935
5	4	=RAND()	5	4	0.19934
6	5	=RAND()	6	5	0.86658
7	6	=RAND()	7	6	0.60579
8	7	=RAND()	8	7	0.80960
9	8	=RAND()	9	8	0.33224

Note: Rows 10-901 are not shown.

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## Sampling from a Finite Population Using Excel

- Put Random Numbers in Ascending Order
- Set calculation option to manual
- Step 1 Select any cell in the range B2:B901
- Step 2 Click the **Home** tab on the Ribbon
- Step 3 In the **Editing** group, click **Sort & Filter**
- Step 4 Choose **Sort Smallest to Largest**

	A	B
1	Applicant Number	Random Number
2	12	0.00027
3	773	0.00192
4	408	0.00303
5	58	0.00481
6	116	0.00538
7	185	0.00583
8	510	0.00649
9	394	0.00667

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## Sampling from a Process

- Populations are often defined by an ongoing process whereby the elements of the population consist of items generated as though the process would operate indefinitely.
- Some examples of on-going processes, with infinite populations, are:
  - parts being manufactured on a production line
  - transactions occurring at a bank
  - telephone calls arriving at a technical help desk
  - customers entering a store

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## Sampling from a Process

- In the case of infinite populations, it is impossible to obtain a list of all elements in the population.
- The sampled population is such that a frame cannot be constructed.
- The random number selection procedure cannot be used for infinite populations.
- A random sample from an infinite population is a sample selected such that the following conditions are satisfied.
  - Each of the sampled elements is independent.
  - Each of the sampled elements follows the same probability distribution as the elements in the population.

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