

# Chapter 1: Data Analysis and Model Building: An Introduction

Outline:

Science and Its Methods

Science and Practical Affairs

What Is a Process?

Statistics in Science

Process Analysis and

Process Control

Statistics: Listening to

Processes

Designed and Observational

Studies

On Using Computers

Chap. 1 - page 1

## Science and Its Methods

Frederick Winslow Taylor—the founder of scientific management

Observed workers shoveling coal, experimented and collected data to find best methods

Chap. 1 - page 2

## Science and Practical Affairs

Practical science uses data and observation (and theory) to discover explanations of how things work

Taylor did not sit in an “ivory tower” wondering how to shovel better—he didn’t even use the theories from human physiology! Rather he experimented and collected data.

Chap. 1 - page 3

## What Is a Process?

In simplest terms, a **process** is a sequence of steps that produces a result.

Two definitions of **process** are given in the 1991 American Heritage Dictionary:

- a series of steps, actions, or operations used to bring about a desired result.
- a series of natural changes by which something passes from one condition to another.

Chap. 1 - page 4



Most processes involve inputs (factors) such as people, procedures, environment, equipment, and policies which combine to produce output (responses) aspects of which can be quantified and measured.

## *Every business is a collection of interrelated processes*

This is true for manufacturing as well as for service businesses

It is true for large, small, or medium sized organizations and for profit or nonprofit organizations.

### Examples of Processes:

- Build a microwave oven and measure its weight.
- Observe how long it takes to get ready to go to class in the morning.
- Observe the monthly U.S. unemployment rate.
- Record the amount of daily sales at Osco's.
- Record annual rainfall amounts for Los Angeles.
- Flip a coin and note whether heads or tails shows.

### Processes Yield Results

### Processes Yield Data

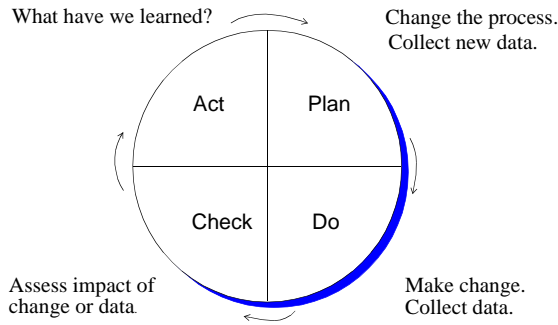
### Process Data Vary

Nearly all processes involve time so that they have longitudinal aspects to their data. There is a first measurement, a second, and so on.

# Process Analysis and Process Control

PDCA—The Deming Wheel

Plan, Do, Check, and Act



Chap. 1 - page 9

Simple observation and surveys are *passive*—they don't try anything new—they investigate *the way things are*.

An **experiment** studies the effects of changes under the control of the investigator.

Experimentation is an **active** rather than passive procedure.

Chap. 1 - page 11

# Statistics: Listening to Processes

**Simple Observation:** Observe a process usually at regular intervals.

## Surveys:

**Elements:** The objects that are measured.

**Universe:** The collection of all elements of interest.

**Sample:** A collection of the elements from the universe that we actually do measure.

Chap. 1 - page 10

Example:

Could you kick a football farther if it were filled with helium rather than air?

Mississippi State coach, Jackie Sherrill, thought so. He complained that the opposing punter was using helium-filled footballs.

*Sports Illustrated* put it to the test!

Chap. 1 - page 12

## Designed and Observational Studies

A **designed study** is one in which the elements are chosen (or assigned treatments) by randomization.

Randomization ensures that all the factors that we are not measuring or not interested in are mixed up among the elements.

A **probability survey** is a designed study in which the sample of elements is chosen at random from the universe.

A **designed experiment** is a designed study in which randomization is used to determine which of several treatments is applied to each element.

(A treatment is a set of conditions setup by the experimenter and applied to elements.)

**Observational studies** are those in which randomization is not used.

(Everything else!)