

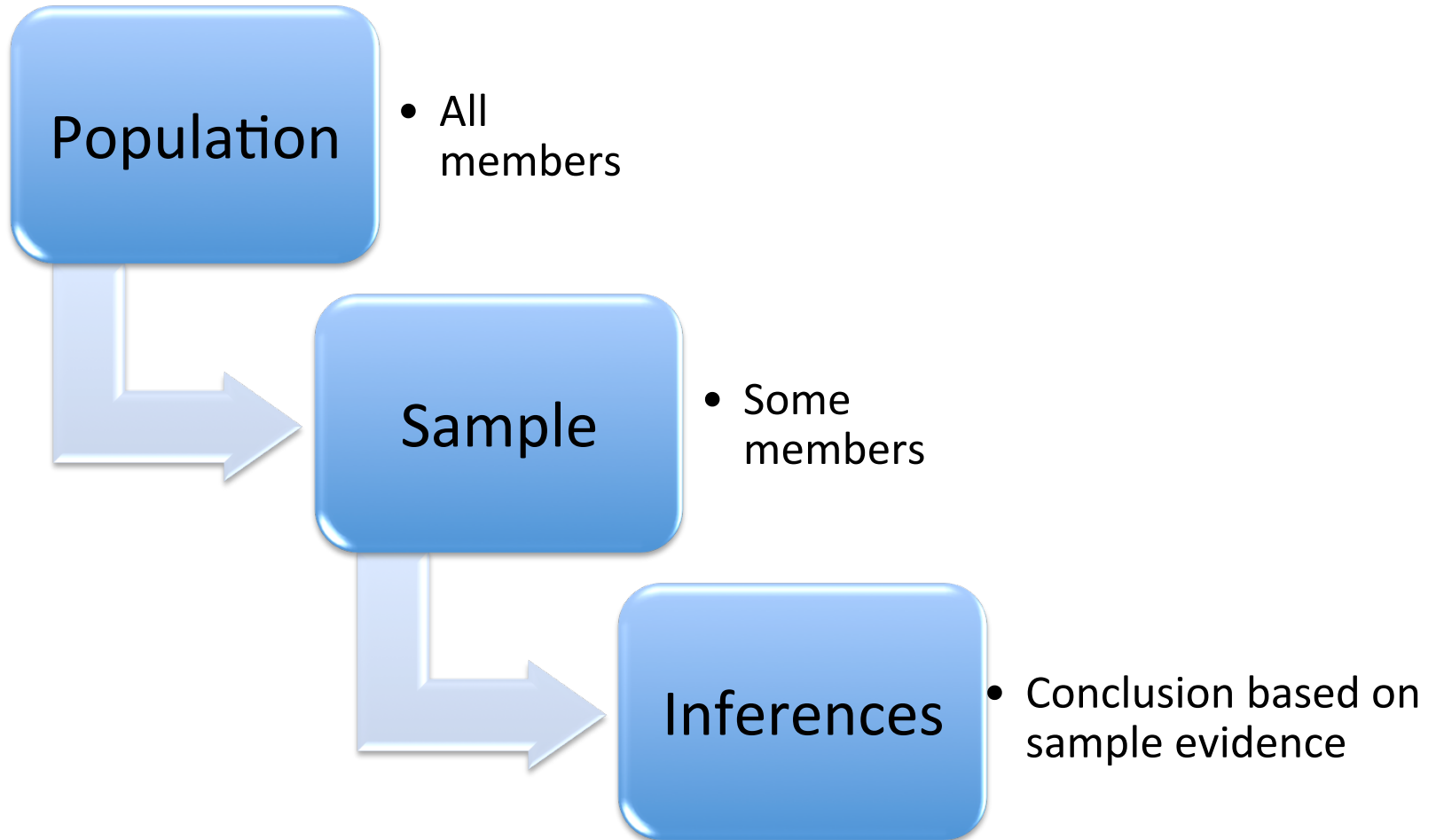
# STAT324: Introductory Applied Statistics for Engineers

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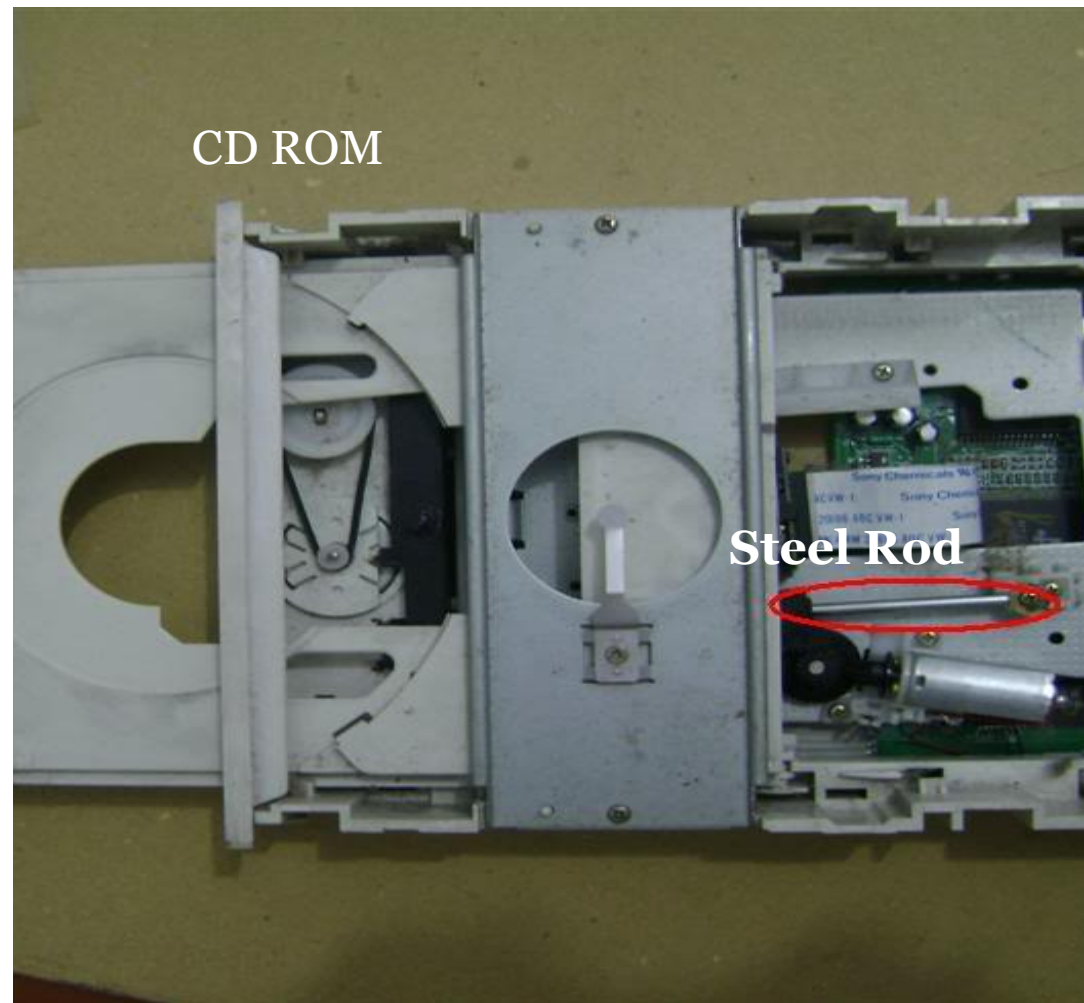
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# Statistics



# Example - CD ROM Manufacturing

- A machine manufacturing **steel rods** used in optical storage devices
- Diameter specification:  $0.45 \pm 0.02 \text{cm}$
- 1000 rods made in the last hour
- **How many of these rods meet the specification?**



# Example Continued

## Measure All 1000

- Time and cost
- What about tomorrow's batch?

## Sample 50 out of 1000

- Cheaper, can do at regular intervals
- Say 46/50 (92%) meet specification - How representative?

# Aspects of Representativeness

1. The engineer needs to compute a rough estimate of the likely size of the **difference between the sample proportion and population proportion**.

Answer: describe using standard deviation, probability distribution, Normal approximation (Textbook Chapters 2 and 4)

2. The engineer needs to indicate the percentage of acceptable rods in the population as an interval of the form **92%±x%**, where x is a number calculated to **provide reasonable certainty that the true population percentage is in the interval**. How should x be calculated?

Answer: using a confidence interval (Textbook Chapter 5).

3. The engineer wants to know whether the **percentage of good rods is acceptable**. How to know whether **at least 90% of the 1000 rods are good**?

Answer: by conducting a hypothesis test (Textbook Chapter 6).

# Other Important Issues

4. How is the amount of carbon in the steel rods related to their tensile strength?

Answer: correlation, regression (Textbook Chapters 7, 8).

5. How can the manufacturing process be adjusted with regard to several factors in order to produce optimal results?

Answer: factorial experiments (Textbook Chapter 9).

6. How can a plan for monitoring the quality of the product manufactured by the process?

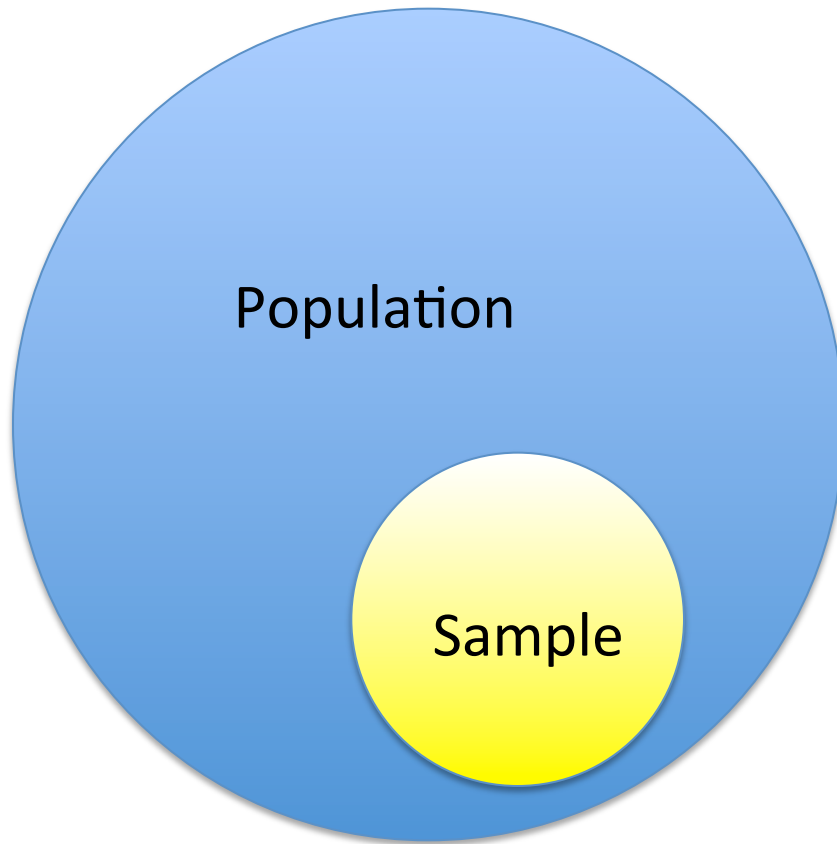
Answer: statistical quality control (Textbook Chapter 10).

# SAMPLING

Population vs sample

Types of sampling

# Sampling from a Population



- Population: entire collection of objects or outcomes
  - heights of all students at a university
- Sample: subset of a population
  - students in Stat 324
  - students on the basketball team
  - 100 randomly chosen students



# Types of Sampling

## Simple random sampling

- sample chosen like a lottery
- assign each member of the population a unique ID, generate random numbers to choose which ones are sampled

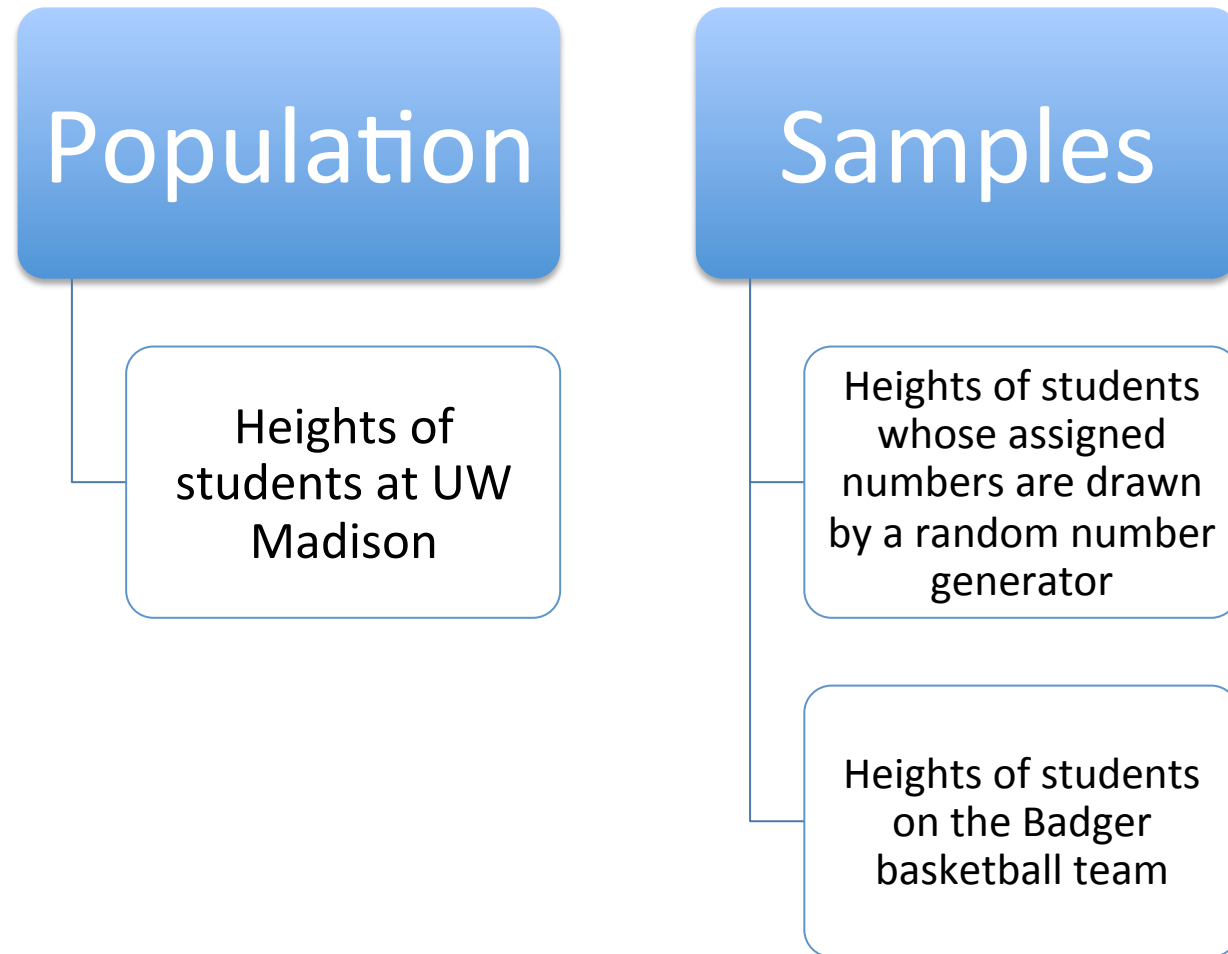


## Sample of convenience

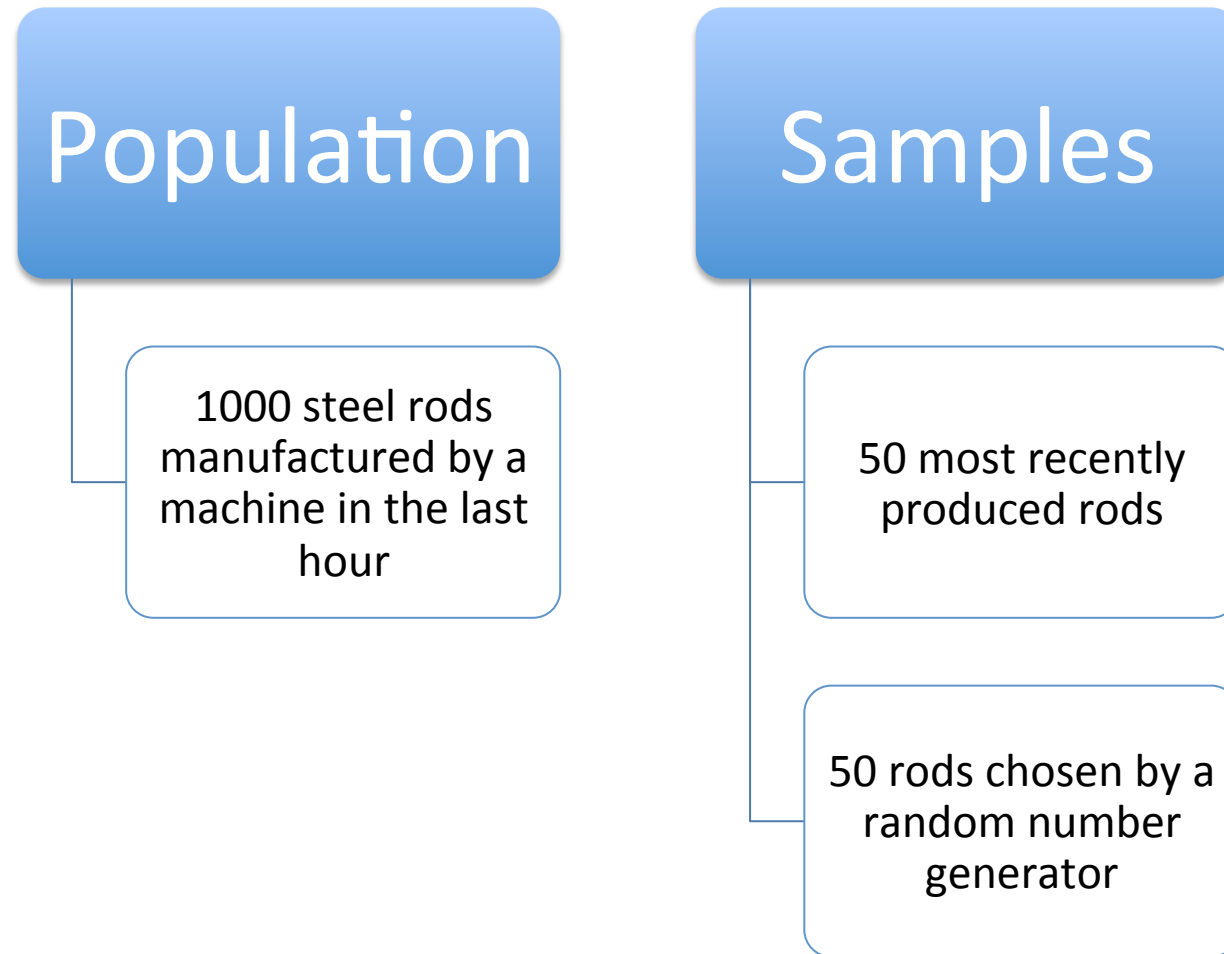
- sample not drawn by a well-defined random method
- can be biased toward certain members of the population



# Example - Sampling Types



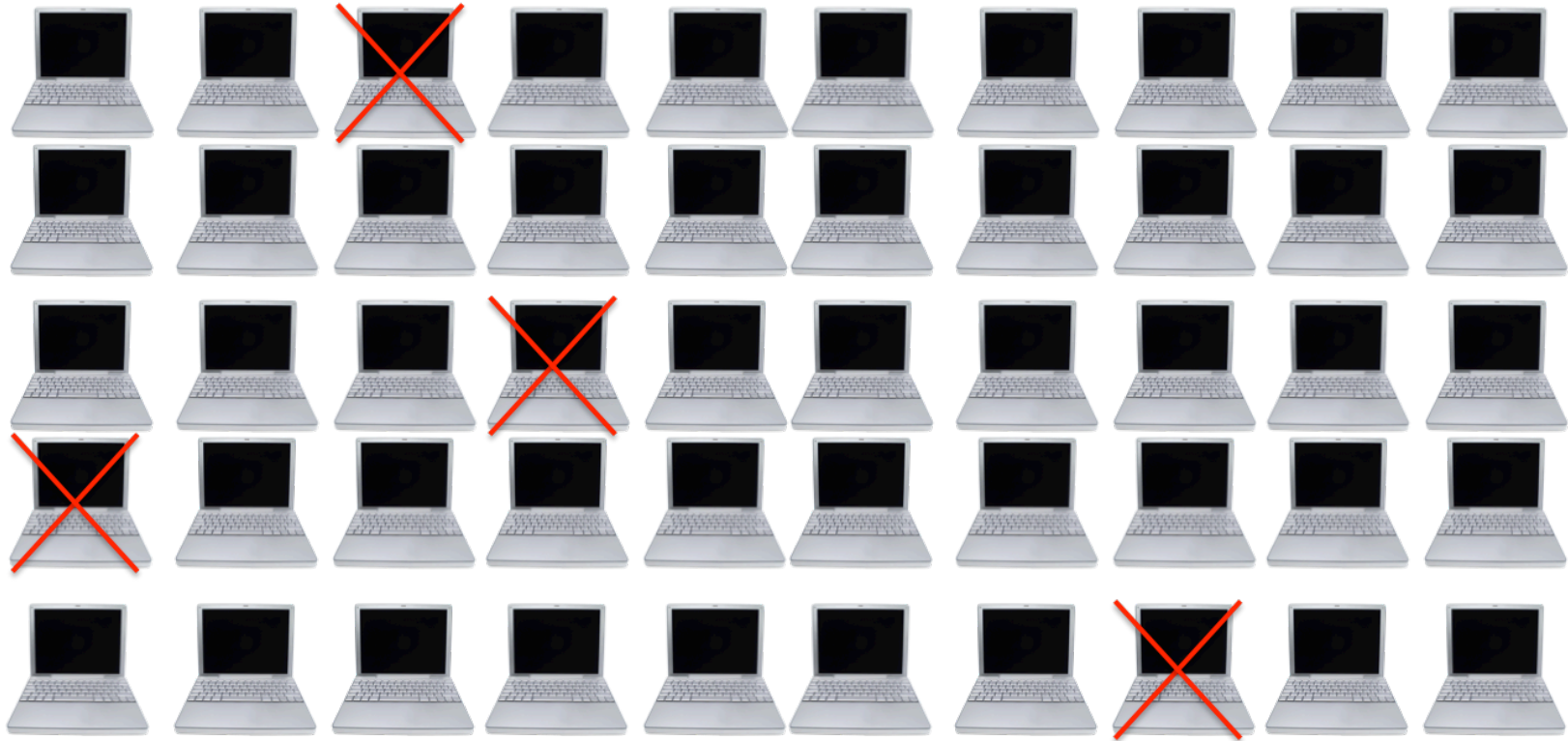
# Example - Sampling Types



# Sampling Variation

- A random sample will be representative of the population, but is not guaranteed to match it exactly
  - If 92% of 1000 rods produced in the last hour are good, it does not mean that exactly 92% of a simple random sample of 50 rods will be good (but it will be close).
- A simple random sample is an approximation (it is not perfect)

# Sampling Exercise



Select 25 computers at random from the population of 50. Is the proportion with good rods (no red X) in the sample close to the proportion with good rods in the population (92%)?

# Next Time

- Summary statistics (1.2)
- Graphical summaries (1.3)