Inferential Statistics and Probability
a Holistic Approach

Chapter 3
Populations and Sampling

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Population vs. Sample

- A **population** is the entire group of individuals or objects of interest to us.
- A **sample** is a subset of the population that we can study by collecting or gathering data.
- Quantities that describe populations are called **parameters.**
- Quantities that describe samples are called **statistics.**

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Example

- A large community college has about 25,000 students. In a study of 85 students from college, it was determined that about 60 of the students have moderate or high math anxiety.
- The **population** is **all** the students at this college.
- The **sample** is the 85 students whose math anxiety was measured.

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Steps of a Statistical Process

- **Step 1 (Problem)**
  Ask a question that can be answered with sample data.
- **Step 2 (Plan)**
  Determine what information is needed.
- **Step 3 (Data)**
  Collect sample data that is representative of the population.
- **Step 4 (Analysis)**
  Summarize, interpret and analyze the sample data.
- **Step 5 (Conclusion)**
  State the results and conclusion of the study.

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Representative Sample

- A **representative sample** has characteristics, behaviors and attitudes similar to the population from which the sample is selected.
- A sample that is not representative is a **biased sample**.

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Observational Study

- An **observational study** starts with selecting a representative sample from a population.
- The researcher then takes measurements from the sample, but does not manipulate any of the variables with treatments.
- The goal of an observational study is to interpret and analyze the measured variables, but it is not possible to show a cause and effect relationship.

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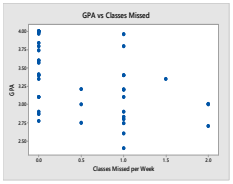
Example of Observational Study

- A group of students at Georgia College conducted a survey asking random students various questions about their scholastic profile.
- One part of their study was to see if there is any correlation between various students' GPA and classes missed.



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Experiment

- An **experiment** starts with a representative sample from a population.
- The researcher will them randomly break this sample into groups and then apply treatments in order to manipulate a variable of interest.
- The goal of an experiment is to find a cause and effect relationship between a random variable in the population and the variable manipulated by the researcher.
- If an experiment is conducted properly, the researcher can control for confounding or lurking variables and test for a **placebo effect**.

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Example of Experiment

- Researchers were studying gambling addiction by speed of play using electronic gaming machines.
- 62 participants played a computerized slot machine with either fast, medium, or slow play.
- Gambling speed had no overall effect on either mean bet size, game evaluations or illusion of control, but in the fast machines, at-risk gamblers employed higher bet sizes compared to no-risk gamblers.
- The findings corroborate and elaborate on previous studies and indicate that restrictions on gambling speed may serve as a harm reducing effort for at-risk gamblers.

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Variables in an Experiment

- **Explanatory Variable:** The variable that is controlled or manipulated by the researcher.
- **Response Variable:** The variable which is being measured and is the focus of the study.
- The researcher tries to answer the question: "Does the explanatory variable (cause) affect the response variable (effect)?
- In the prior gambling example, the explanatory variable was the speed of the machine, and the response variable was the bet size.

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Placebos and Blinding

- A **placebo effect** is when participant will respond in a positive way to a treatment with no active ingredients.
- This treatment with no active ingredients is called a **placebo**.
- A **single blind study** is where the participant does not know whether the treatment is real or a placebo.
- A **double blind study** is where neither the administrator of the treatment nor the participant knows whether the treatment is real or a placebo.

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Example

- An researcher for a pharmaceutical company is conducting research on an experimental drug to reduce the pain from migraine headaches.
- Participants with migraine headaches are randomly split into 3 groups. The first group gets the experimental drug (**Treatment Group**). The second group gets a placebo, a fake drug (**Placebo Group**). The third group gets nothing (**Control Group**).
- The researcher found that pain was reduced for both the treatment group and the placebo group, establishing a placebo effect. The researcher must then compare the amount of pain reduction in the treatment group to the placebo group to determine if the treatment was effective.

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Probability Sampling Methods

- Properly done, probability or scientific sampling will produce a representative sample.
  - Simple Random Sampling
  - Stratified Sampling
  - Systematic Sampling
  - Cluster Sampling

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Non-Probability Sampling Methods

- Non-probability sampling methods have immeasurable biases and will usually not produce a representative sample.
  - Convenience Sampling
  - Self-selected Sampling

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Sources of Bias in Sampling

- **Selection bias** – when the sampling method does not produce a representative sample.
- **Self-selection bias** – when participants who volunteer are not representative of the population.
- **Non-response bias** – when people are intentionally or non-intentionally excluded from participation or choose not to participate in a survey or poll.
- **Response bias** – when the wording of the questions in surveys affect the response.

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