# Data Analytics with R

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**Introduction to Data**

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# Agenda

- Experiments Case Study: using stents to prevent strokes
- Data basics.
- Sampling principles and strategies.

# Case: Stents to prevent strokes

# Using stents to prevent strokes

| Patient | group | 0-30 days | 0-365 days |
|---|---|---|---|
| 1 | treatment | no event | no event |
| 2 | treatment | stroke | stroke |
| 3 | treatment | no event | no event |
| ⋮ | ⋮ | ⋮ | |
| 450 | control | no event | no event |
| 451 | control | no event | no event |

Figure 1: Results for five patients from the stent study.

# Using stents to prevent strokes

| | 0-30 days | | 0-365 days | |
|---|---|---|---|---|
| | stroke | no event | stroke | no event |
| treatment | 33 | 191 | 45 | 179 |
| control | 13 | 214 | 28 | 199 |
| Total | 46 | 405 | 73 | 378 |

Figure 2: Descriptive statistics for the stent study.

# Using stents to prevent strokes

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Exercise: Calculate the proportion of people who had a stroke in the treatment and control groups.

# Data Basics

# Observations, variables, and data matrices

Consider the following table.

| | loan_amount | interest_rate | term | grade | state | total_income | homeownership |
|---|---|---|---|---|---|---|---|
| 1 | 7500 | 7.34 | 36 | A | MD | 70000 | rent |
| 2 | 25000 | 9.43 | 60 | B | OH | 254000 | mortgage |
| 3 | 14500 | 6.08 | 36 | A | MO | 80000 | mortgage |
| ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ |
| 50 | 3000 | 7.96 | 36 | A | CA | 34000 | rent |

Figure 3: Four rows from the `loan50` data matrix.

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- What does the first row represent?
  - Loan amount: $ 7500
  - Borrower's location: MD (Maryland)
  - Interest rate on the loan: 7.34%.

# Practice

Construct the gradebook for a course in R assuming that there are five students, two assignments, and one exam.

# Types of variables

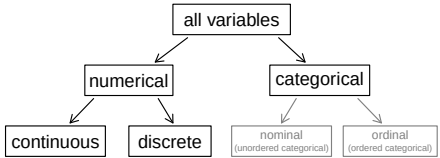
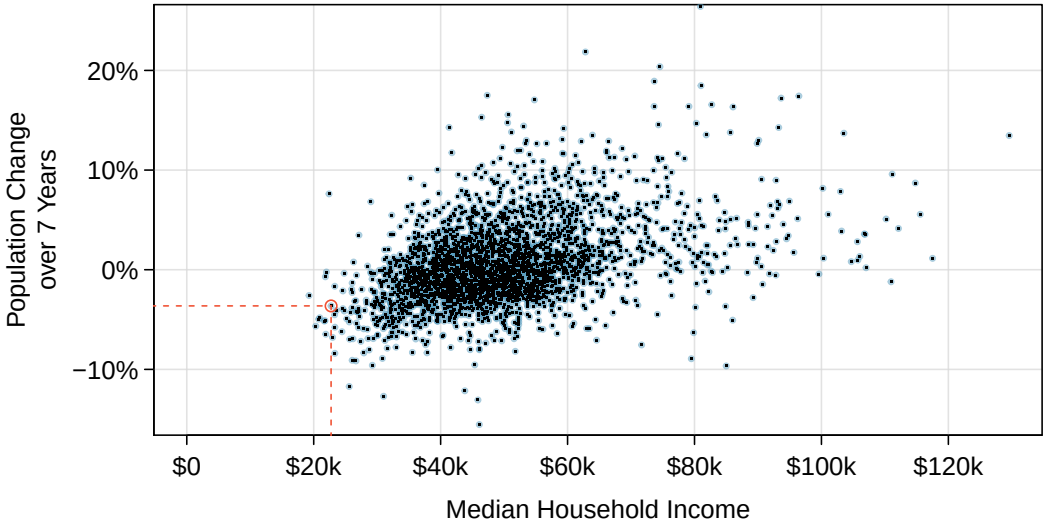



Figure 4: Breakdown of variables into their respective types.

# Relationship between variables



# Practice

Examine the variables in the `loan50` data set. Create two questions about possible relationships between variables in `loan50` that are of interest to you.

# Explanatory and Response Variables

Think about the following question.
What will be the increase in sales if there is a one percent rise in ad expenditure?

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Think about the following question.
What will be the increase in sales if there is a one percent rise in ad expenditure?
The framing of the question is such that we seek a directional relationship between spending on ads and sales.

`Explanatory Variable` $\Rightarrow$ `Response Variable`

# Sampling Principles and Strategies

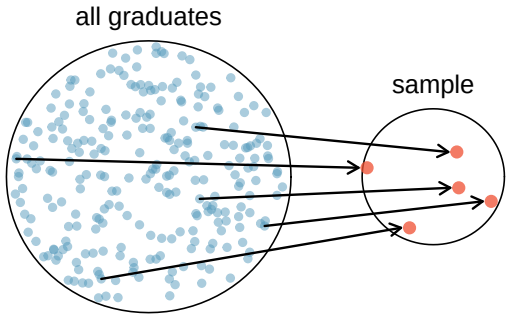
# Introduction

Consider the following possible responses to the three research questions:

- I subscribed to Spotify after I got tired of their annoying ads. Those annoying ads lead to greater number of subscriptions.
- A student attending Random Coaching Classes was ranked first in the Pointless Entrance Exam. Therefore, on average, kids who attend Random end up in Pretentious Institute of Meritocracy.
- An acquantaince who was infected with coronavirus was cured due to Coronil. Coronil is the cure for coronavirus.

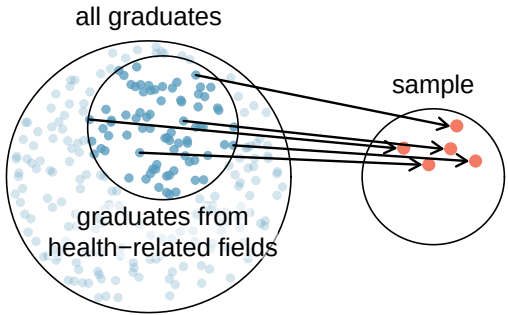
# Sampling from a population

Objective: Estimate the time to graduation for university undergraduates in the last five years by collecting a sample.



# Sampling from a population: Example

Let's suppose that a student from medicine is being asked to select survey respondents and he ends up oversampling other students from his own field. This introduces a **bias**.



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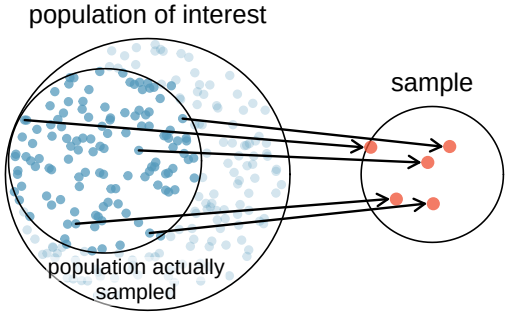
Even after having chosen the sample carefully, some people may choose not respond. This introduces another form of bias known as the **non-response bias**.



# Sampling Methods

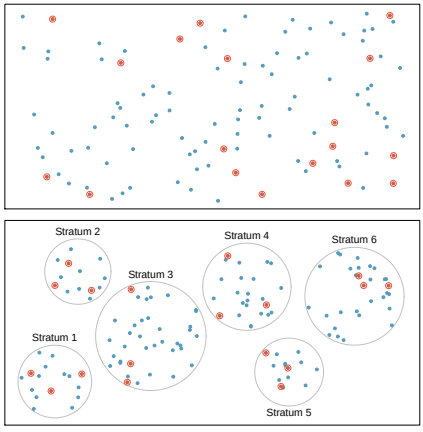



Figure 5: Examples of simple random and stratified sampling. In the top panel, simple random sampling was used to randomly select the 18 cases. In the bottom panel, stratified sampling was used: cases were grouped into strata, then simple random sampling was employed within each stratum.

# Sampling Methods

- **Simple random sampling**
  - Example: You want to estimate salaries of IPL players (there are eight IPL teams).
  - Let's assume that there are 160 players, and you are going to sample 16 of them.
  - You write the names of the players onto slips of paper.
  - Randomly pick 16 players.

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- **Stratified sampling**
  - You will choose two players from each team (randomly of course).
  - This is especially useful when the observations in each *stratum* are very similar.

# Sampling Methods

- **Cluster sample**:
  - Break up the population into many groups.
  - Choose a fixed sample of clusters.
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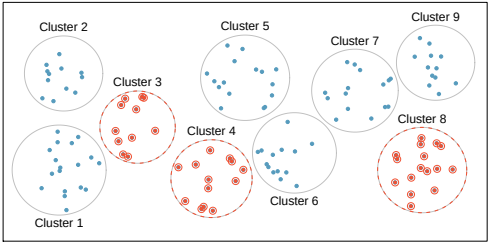
  - Break up the population into many groups.
  - Choose a fixed sample of clusters.
  - Survey all observations from each of these clusters.
- **Multi-stage sample**
  - Random sampling within each cluster.

These approaches are useful when clusters are largely similar, but there's lot of variation within each of these clusters.

# Sampling Methods




- **Cluster sampling (Top Panel)**
  - Data binned into 9 clusters.
  - 3 out of 9 were sampled.
  - Everyone in those 3 clusters were sampled.
- **Multistage cluster sampling (Bottom Panel)**
  - Randomly select three clusters.
  - Randomly draw people from each of these clusters.