Statistics for Public Health Research

Center for Data Research and Analytics

Session 3:

Research Question-Driven Data Analysis

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Outline

Part-1

- Recap of Session-2
- In-class GitHub exercise on
  - ✓Research Question
  - ✓Population
  - ✓Parameter
- Data requirement to answer a research question
- In-class practice

Part-2

- Introduction to R

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Population

- A population is the **complete collection** of similar objects, items, or subject of interest
- Each object, item, or subject included in the population is the **study unit**
- In a research study usually, we *cannot reach* to each study unit in a population, we take a random sample (*To be discussed later*) to represent the population
- Study unit could be distinct that can be counted, non-distinct that cannot be counted

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Parameter & Research Question

- A **parameter** is a **measurable characteristic** of a population of interest
- A Research Question is usually a WH type question that seeks information **about the parameter** of a **population of interest**

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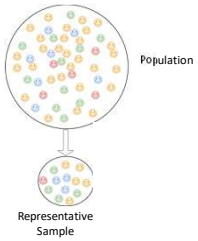
Sample and Estimator

- In Statistics, a sample is a representative part of a population
- We estimate (not determine) the parameter from a sample and **generalize** it to the population.
- The estimate of the parameter is called **estimator**



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Sources of Bias in Research

- Sampling bias
- Measurement bias
- Due to inappropriate statistical method
- Confounding

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Summary

- In research questions, we ask about the parameter of a population
- The population is may not accessible, so we use a random sample from the populations
- We estimate the parameter based on a sample and conclude about the population with the estimate
- Bias in research limits the generalizability of the finding from sample to the population
- Bias in research could be due to the sampling, measurement scale and inappropriate statistical method
- Know as much as possible the sources of bias in research

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Activity-1 (5-Minutes)

- Please visit https://github.com/jaynal83/sphr/discussions/3
- Please write response to the forum post

  Write an example research question. Define population and parameter(s) from the research question. How can we get a random sample about the parameter of interest from the population? Please mention possible source of bias if there is any.
- If you don't have GitHub account, please create one now and then respond to the post

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Session 3

Research Question-Driven Data Analysis

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Quiz

- In a quantitative scientific article, we usually see a demographic table, **why do we need this table**?

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Research Question-1

- What is the proportion of under 5 children suffers from anemia in Bangladesh in 2021?
- ***Population***:
- ***Parameter***:

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Research Question-1

- What is the proportion of under 5 children suffers from anemia in Bangladesh in 2021?
- ***Population***: All live children <5 years in Bangladesh in 2021
- **Parameter**:

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Research Question-1

- What is the proportion of under 5 children suffers from anemia in Bangladesh in 2021?
- ***Population***: All live children <5 years in Bangladesh in 2021
- ***Parameter***: **Proportion** of <5 children with anemia

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Data Requirement

- Define **Anemia** to make it measurable and comparable
- Conduct a survey of **N** children whose age is <5 years
- Define a variable e.g., **`childID`** containing survey ID of each children
- Define a variable let's say **`anemia`** having two category, "*Yes*" and "*No*"
- Prepare a coding plan; **codebook** of the variables (see next slide)

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Codebook or Data Dictionary

Name of Variable	Variable Label	Type	Possible Values	Value Label (if any)
`childID`	ID of surveyed child	Character of length 9 with a format `HxxxCyyyy`	`H001C0001`	
`anemia`	Status of Anemia	Numeric with single digit	`0 or 1`	`1 = Yes, 0 =No`

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Data

childID	anemia
H001C0001	1
H002C0001	0
H002C0002	0
H003C0001	1
H004C0002	0
H005C0001	0

- Count 1's in anemia column
- Divide the count of 1's with total number of children surveyed to get the estimated proportion

What other variable do we need to appropriately answer our research question?

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Extended Codebook

Name of Variable	Variable Label	Type	Possible Values	Value Label (if any)
childID	ID of surveyed child	Character of length 9 with a format HxxxCyyyy	H001C0001	
anemia	Status of Anemia	Numeric with single digit	0 or 1	1 = Yes, 0 =No
Age	Age of children in months	Numeric with two digits	Values between 1 to 60	
Nfammem	No. of member in the household	Numeric with two digits	Values between 1 to 20	
Medu	Mothers' education in schooling years	Numeric with two digits		
Fedu	Fathers' education in schooling years	Numeric with two digits		
Ruralurban	Place of resident	Numeric with single digit	0 or 1	1 = Urban 0 = Rural
famincome	Household income	Numeric with single digit	1, 2, 3, 4, 5	

To answer the research question appropriately, and to ensure the findings are generalizable to the population, we need some additional characteristics

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How to Report

	Average (SD) Or Freq (%)
Age of Children (in months)	xx.x (yy)
No. of family members	
Mothers' education	
Father's education	
Family income (monthly) 0-10k 10k-20k 20k-35k 35k-60k 60k-above	
Place of resident Rural Urban	

This is a guiding template of a demographic table, where we usually report descriptive statistics.

The results presented in this table is to reflect the basic characteristics of the study population

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Research Question-2

- What is the proportion of Covid-19 cases among fully vaccinated and unvaccinated adults in Bangladesh?
- Population:
- Parameter:
- Let's fill out the codebook now

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Codebook

Name of Variable	Variable Label	Type	Possible Values	Value Label (if any)
ID				
Vac_status				
Age				
Sex				
ruralurban				
Wealth				
casestatus				
Slum_nonslum				
occupation				
education				
workplace				

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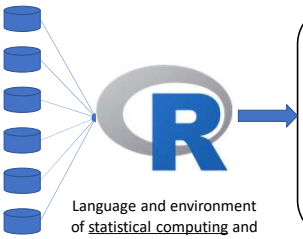
What is R?

Data



Language and environment of statistical computing and graphics

Graphs, Report and analytical dashboard

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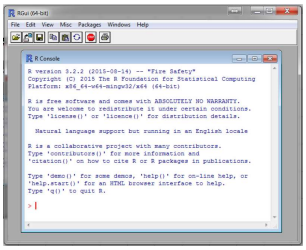
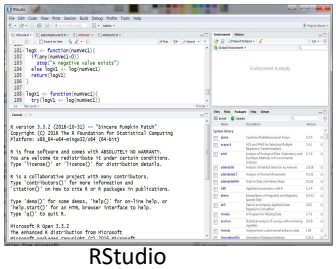
R vs. RStudio



R



RStudio

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R Libraries & Repositories

- **Library:** A collection of customized pre-defined functions to perform tasks
- **Repository:** Collection of available libraries:
  - CRAN
  - CRAN (extras)
  - BioC software
  - BioC annotation
  - BioC experiment
  - BioC extra
  - R-Forge
  - rforge.net
  - Omegahat

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Installing & Loading R Libraries

- **Net Installation**
  - Open R console
  - Connect the PC with internet
  - Type:
    `install.packages("pkgname",lib="location",dependencies=TRUE)`
  - `install.packages("ggplot2",dependencies = TRUE)`

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Installing & Loading R Libraries

- **Installation**
  - Open R console
  - Connect the PC with internet
  - Type:
    `install.packages("pkgname", lib="location",dependencies =TRUE)`
  - `install.packages("ggplot2",dependencies = TRUE)`
- **Loading**
  - `library(ggplot2)`

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Supported Data Files in R

- An Excel file (*.xls, *xlsx)
- **A Comma Separated Values (CSV) file**
- Plain text file with columns separated by tab or space
- Stata data file (*.dta)
- SPSS data file (*.sav)
- … and many others

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Importing (or Reading) a Data File

- We have a csv file "`data_for_session_3.csv`" to import into R
- `read.csv()` is a typical function to import the csv file into R environment
- The complete code structure is:
  - `read.csv("path-to-the-csv-file", as.is=TRUE)`

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Seeking Help in R

- To know how to use a function in R, we can check the help documentation by typing the following line into R console
- `help(read.csv)` or `?read.csv`
- Each of the help page is a standalone guide to use a function of interest
- The documentation of all functions in R follows same structure and easy to follow with the examples provided

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Summary

- A research question is the guiding force to understand
  - Population
  - Parameter
  - Data requirement
- A research question also helps us to prepare appropriate data collection tools
- R is a language and environment for data analysis and visualization
- Importing a csv file into R environment for further work
- Seeking help in R to learn independently

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