Lecture 1
Introduction

STAT 8010 Statistical Methods I
May 16, 2023

Whitney Huang
Clemson University

Who is the instructor?

Who am I?

- **Fourth year** Assistant Professor of Applied Statistics and Data Science
- Born in Laramie, Wyoming, grew up in Taiwan

- With a B.S. in Mechanical Engineering, switched to Statistics in graduate school
- Got a Ph.D. (Statistics) in 2017 at Purdue University.

How to reach me?

- **Email:** wkhuang@clemson.edu
- **Office**: O-221 Martin Hall
- **Office Hours**: TBD and by appointment via Zoom

Class Policies / Schedule

Logistics

- **Course modality:** Asynchronous online

- There will be two online exams and a (comprehensive) online final. The (tentative) dates for the two exams are:

  - **Exam I**: May 31, Wednesday

  - **Exam II**: June 12, Monday

  The **Final Exam** will be given on Thursday, June 22

- There will be some homework assignments (~ 5):

  - To be uploaded to Canvas by 11:59 pm ET on the due dates

  - Worst grade will be dropped

- No classes on May 29 (Memorial Day)

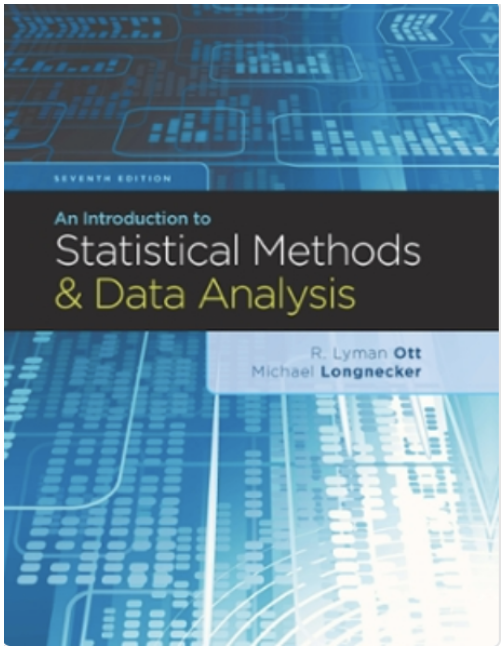
Class Website

CANVAS and my teaching website (link: https://whitneyhuang83.github.io/STAT8010/2023SummerI.html)

- Course syllabus [Link] / Announcements
- Lecture slides/notes
- Homework assignments
- Exam and homework schedule
- Data sets for lectures and homework
- R codes

Reference Books

An Introduction to Statistical Methods and Data Analysis, 6th Edition. **Lyman Ott and Micheal T. Longnecker, Duxbury, 2010**; **ISBN-13:** 978-1305269477



OpenIntro Statistics, 4th Edition. **David Diez, Mine Çetinkaya-Rundel, and Christopher D Barr, 2019**

Evaluation

- Grade Distribution:

Homework:	20%
Exam I	25%
Exam II	25%
Final Exam	30%

- Letter Grade:

>= 90.00	A
88.00 ~ 89.99	A-
85.00 ~ 87.99	B+
80.00 ~ 84.99	B
78.00 ~ 79.99	B-
75.00 ~ 77.99	C+
70.00 ~ 74.99	C
68.00 ~ 69.99	C-
<= 67.99	F

Tentative Schedule

Week	Topic
1	Introduction & Exploratory Data Analysis
2	Probability
3	Sampling; Inference for a Single Population Mean
4	Inference for Multiple Population Means
5	Categorical Data Analysis; Correlation and Regression
6	Regression Analysis

Computing

We will use software to perform statistical analyses. The recommended software for this course is R / RStudio

- a **free/open-source** programming language for statistical analysis
- available at `https://www.r-project.org/` (`R`); `https://rstudio.com/` (`Rstudio`)
- Youtube videos showing how to install R and RStudio [Link]

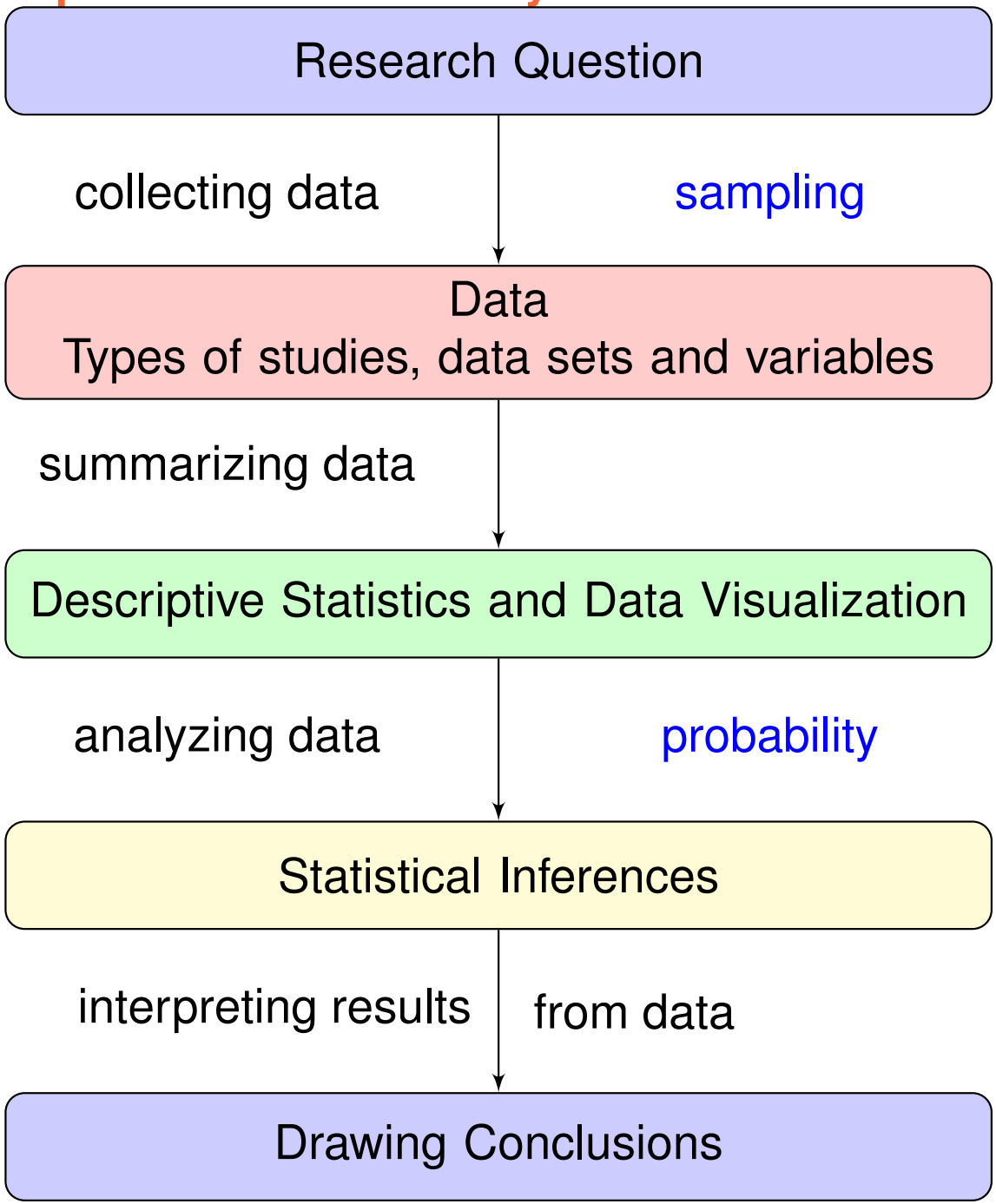
You are welcome to use a different package (e.g. SAS, JMP, SPSS, Minitab) if you prefer (but at your own risk)

Class Overview

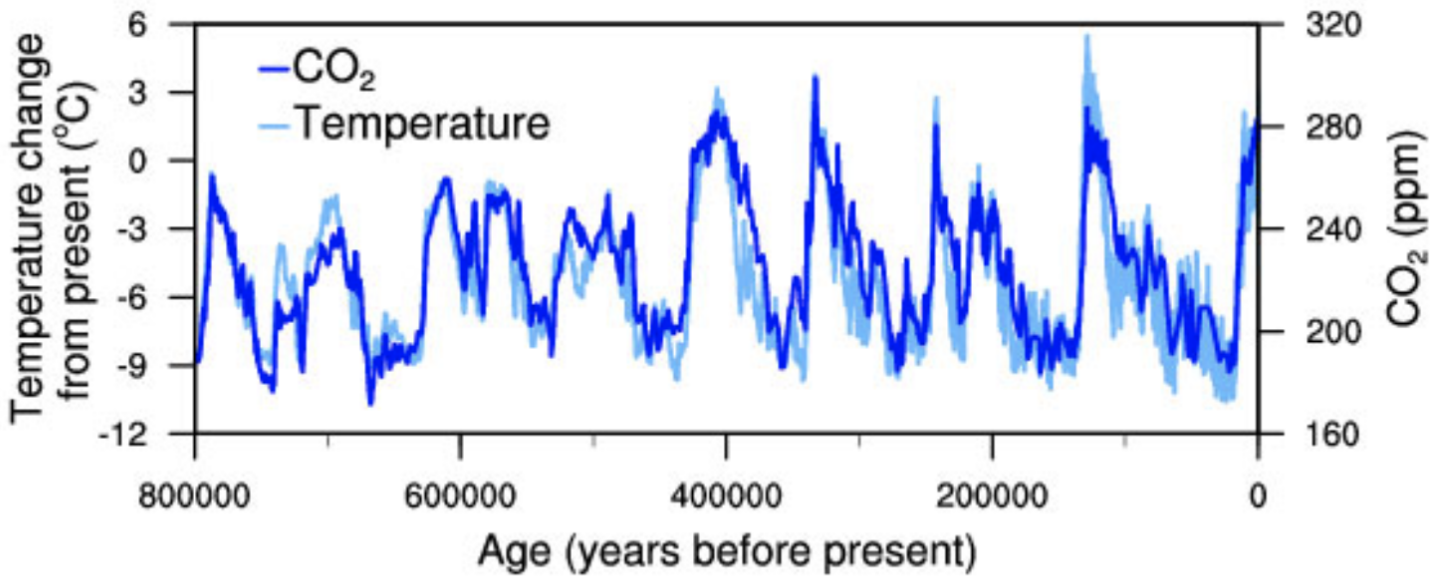
Motivation: Why Study Statistics?

- To be able to effectively conduct (empirical) research
- To be an informed “consumer”
- To further develop critical and analytic thinking skills

Typical Steps in Statistical Study



Temperature and Carbon Dioxide CO_2



Temperature change (light blue) and carbon dioxide change (dark blue) measured from the EPICA Dome C ice core in Antarctica (Jouzel et al. 2007; Lüthi et al. 2008).

Research questions:

- Does temperature correlate with CO_2? If so, how to predict temperature using CO_2?
- Can we make some statement about the causation between temperature and CO_2?

Basic Concepts

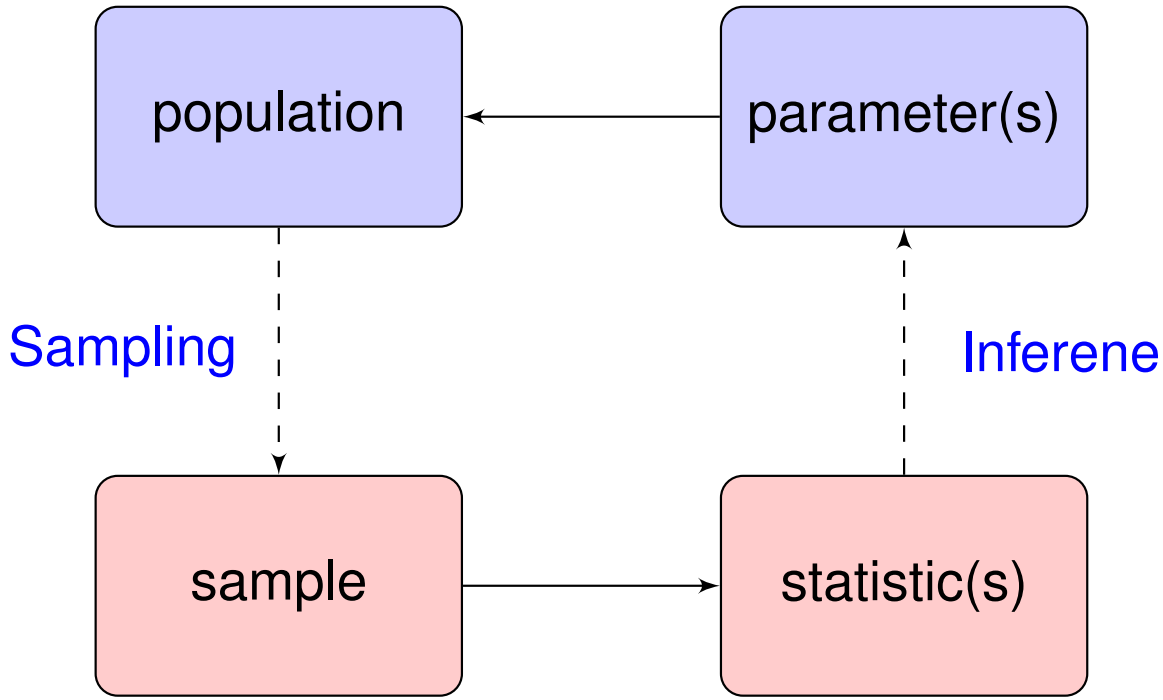
Terminology

- A **unit** is a single entity (person or object) whose characteristics are of interest
- A **population of units** is the complete collection of units about which information is sought
- A **population** is a set of all measurements corresponding to each unit in the entire collection of units about which information is sought
- A **sample** is a subset of measurements selected from the population of interest

Statistical Science concerned with using sample information to make inference about populations

Population (parameters) vs. Sample (statistics)

- We use parameter(s) to describe the population of interest
- We use statistic(s) to describe the sample with respect to the population of interest



Understanding Data: Types of variables

A **variable** is a characteristic of a unit that may vary for different observations

There are two main types of variables, qualitative (aka categorical) and quantitative (aka numerical)

- Qualitative variable: has labels or names used to identify an attribute of a unit. Qualitative data use either the **nominal** or **ordinal** scale of measurement

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  - Ratio: ratios of quantities that are meaningful e.g. Height

Example

Grade	Major	GPA	Credit hours
Sophomore	Psychology	3.14	30
Senior	Spanish	2.89	105
Senior	Religion	3.01	99
Freshman	Philosophy	2.45	12

1. How many units are in the data set?
2. How many variables are in the data set?
3. What type of variable is each variable in the data set (be sure to answer both qualitative or quantitative as well as nominal, ordinal, interval, or ratio).

Example

Answer what type of variable each of the following are

1. Smoking status
2. Income
3. Level of satisfaction
4. Clothing size (s, m, l, xl)
5. Time taken to run a mile

Observational vs. Experimental Studies

Depending on how a study was conducted, we have the following types of studies:

- Observational study: a study in which the investigator **observes** a variable of interest of an existing sample in order to draw conclusions
- Experimental Study: a study in which the investigator examines how a response variable behaves when the researcher **manipulates** one or more factors in order to determine the effect of those factors on the response.

Example

State whether the study is observational or experimental

- A researcher wants to know if smoking during pregnancy leads to children with lower IQ scores. She looks at 200 pregnant women and records smoking status along with the subsequent IQ score (measured a few years after birth)
- A scientist tries his weight loss drug on a group of monkeys with identical diets. 40 monkeys are randomly assigned to either get the drug or not get the drug (20 in each group). The weight gained or lost was recorded for each monkey.

Types of Data sets

Depending on how the data were collected, we have the following types of data sets:

- Cross-sectional dat: data collected at the same or approximately the same point in time
- Time series data: data collected over several time periods
- Spatio-temporal data: data collected at different “locations” over several time periods

Example

For this problem, state whether the variables included are cross-sectional or time series

1. United States current temperatures
2. Temperatures in Clemson from 1950-2015
3. Total salary of the LA Lakers throughout the 2010s
4. Salaries of all NBA teams in 2019.

Summary

In this lecture, we learned

- Typical steps in statistical study
- Terminology
  - Population vs. Sample
  - Types of variables, studies, datasets

In next lecture we will learn how to summarize data both graphically and numerically