

# DATA ANALYSIS

Week 1: Statistical Thinking / What are data?

# logistics

## Before/End of Tuesday

- Read the [syllabus](#) for this course. If you have questions about the syllabus, then please ask them in class or on the pre-class survey.
- Complete the [Pre-class survey](#)!

## Before Thursday

- Watch: [Introduction to Google Sheets](#). Leave an annotation to complete participation.
- Read [Chapter 1](#) from the Gravetter & Wallnau (2017) textbook. Leave an annotation for any questions you have.
- Take the [Skills Assessment Exam](#) from the textbook (Appendix A) and submit a reflection. This will help me support you better in the course.

Here are the to-do's for this week:

- Submit [Week 1 Quiz](#) (due Sunday midnight)
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- Extra credit opportunities:
  - Submit [Pre-class survey](#) (1 point)
  - Submit [Extra Credit Questions](#) (1 point for 8 submissions)
  - Submit [Optional Meme Submission](#) (1 point for winners!)

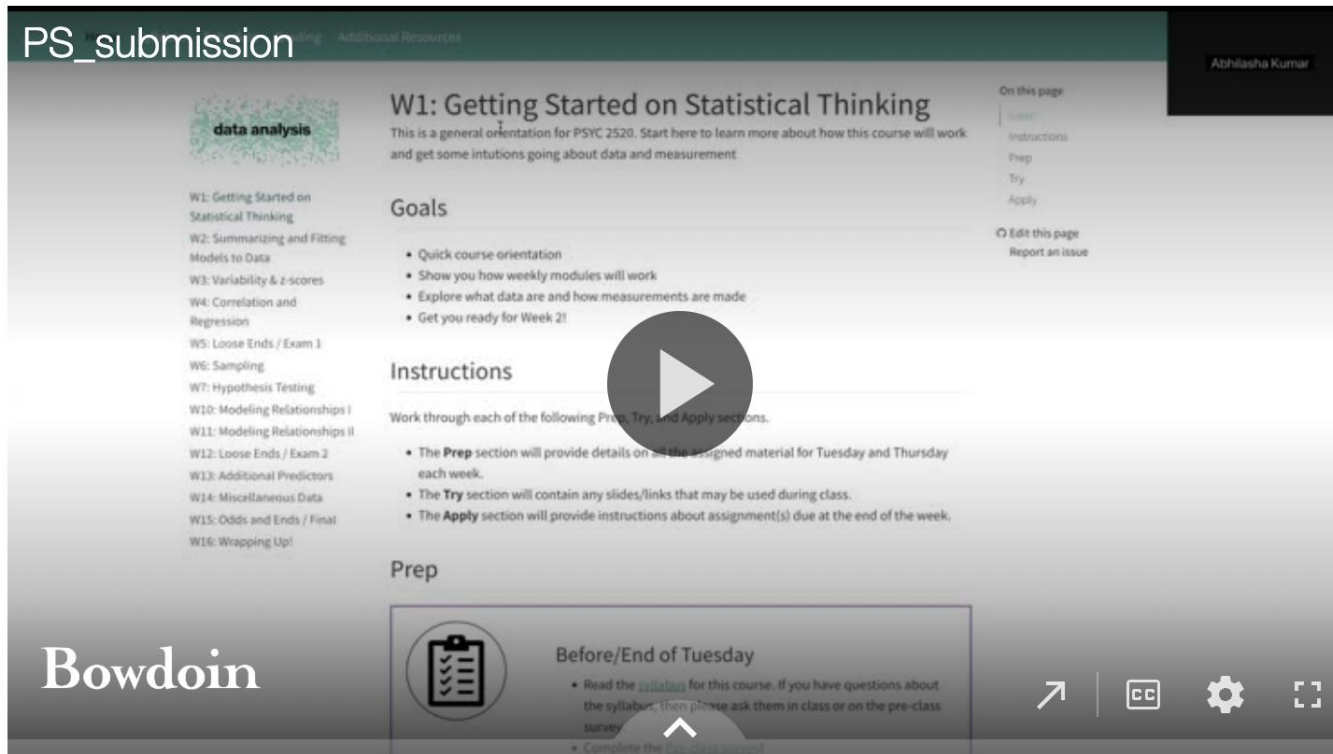
# Problem Set 1: First Attempt ↕

[Start Assignment](#)

Due Feb 3 by 11:59pm    Points 2.5    Submitting a file upload    File Types pdf

Please complete the problem set available [here](#) . Please submit a PDF of your solution sheet.

- Make sure you are looking at the correct problem set.
- Please follow the template provided in the link above for the specific problem set.
- Please watch the video below to make sure you are following the submission guidelines for problem sets.



PS\_submission

data analysis

W1: Getting Started on Statistical Thinking

This is a general orientation for PSYC 2520. Start here to learn more about how this course will work and get some intuitions going about data and measurement.

Goals

- Quick course orientation
- Show you how weekly modules will work
- Explore what data are and how measurements are made
- Get you ready for Week 2!

Instructions

Work through each of the following Prep, Try, and Apply sections.

- The **Prep** section will provide details on all the assigned material for Tuesday and Thursday each week.
- The **Try** section will contain any slides/links that may be used during class.
- The **Apply** section will provide instructions about assignment(s) due at the end of the week.

Prep

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Bowdoin

## Problem Set 1 (summarizing & means)

Attempt 1 due date: Feb 3, 2025

-  **PS1: Solution Template** [Use this template to create your own solution sheet]
-  **PS1 worksheet template** [Use this template to create your own worksheet]

[Please watch this video that describes how to submit problem sets](#)

Total number of problems (including sub-parts): 32  
75% cutoff for a reasonable first attempt: 24

- Chapter 1 Problems: 8, 10, 18, 20, 22
  - 22a has a typo: it should be “add the scores and then square the sum”
- Chapter 2 Problems: 4, 6, 12, 14, 18,
- Chapter 3 Problems: 10, 12, 14, 20, 22



# more Qs

- Is there flexibility for students with accommodations?
- Do we need to buy the textbook?  
Can we use it online.
- What is your favorite part about teaching data analysis?

## Data Analysis: Lingerin Questions

Use this form to post any questions you may have from the class or week. We will try to answer them in class!

### ▼ Course Information and Course Resources

 Course Website 

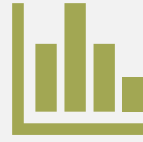
 Lingerin Questions Form 

 Problem Sets 

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# today's agenda



introduce statistical  
thinking



define population /  
sample / data

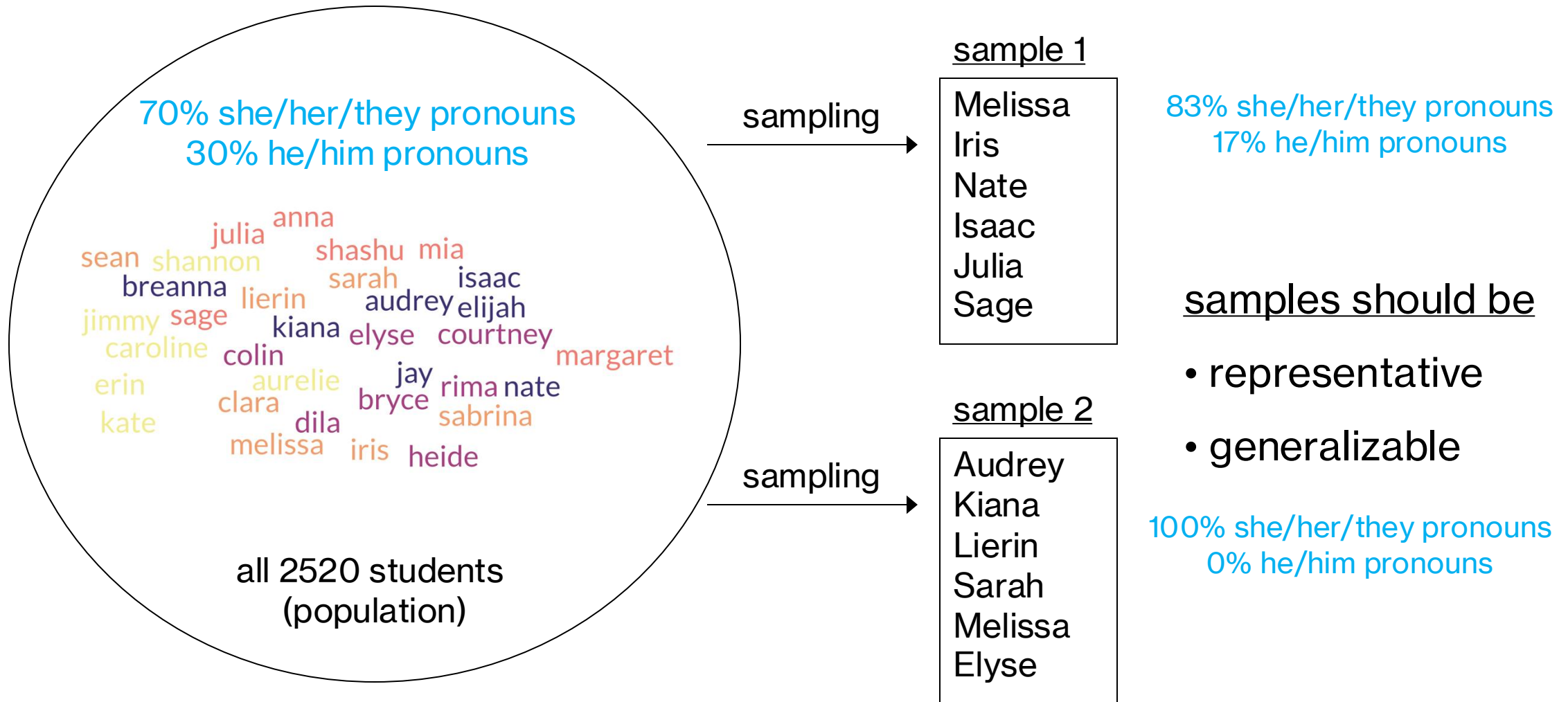


discuss scales of  
measurement / reliability

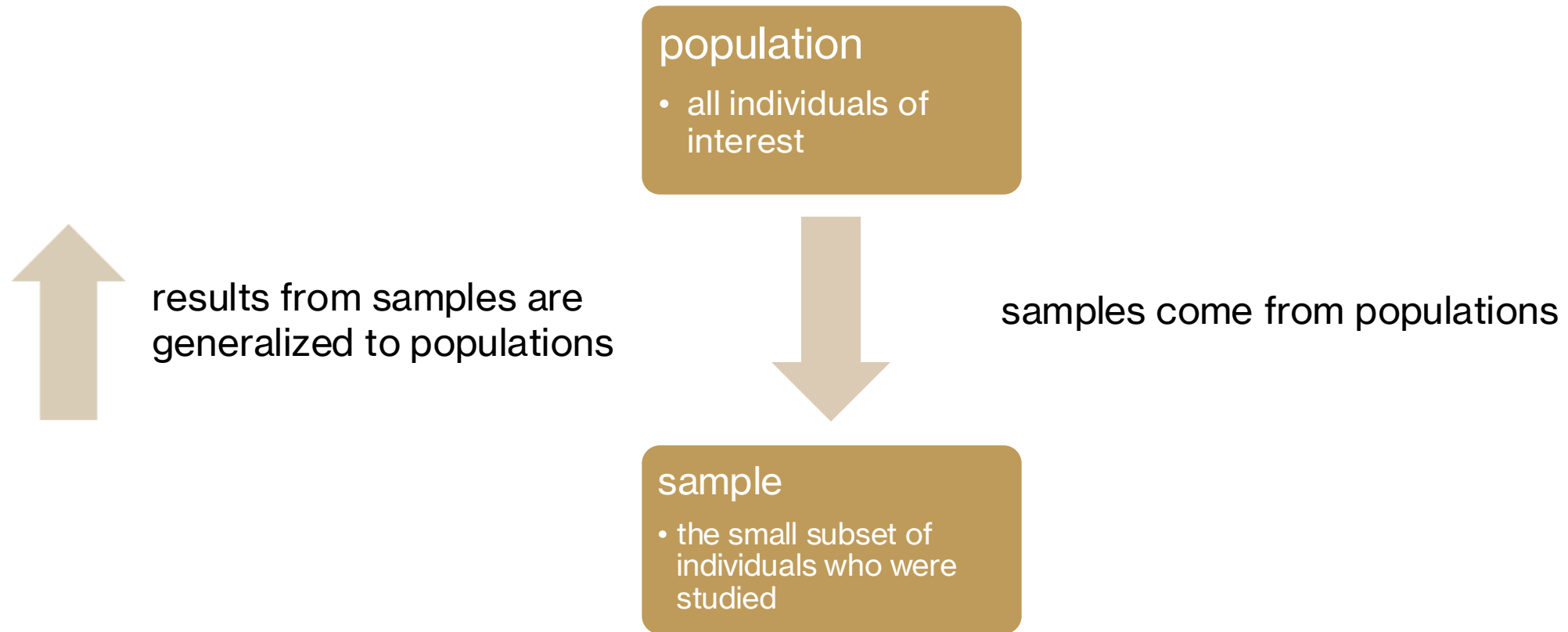
# what is statistical thinking?

- understanding the **complex** world in **simple** terms
  - summarization + uncertainty
- different from **other forms of thinking**, e.g., human intuition, heuristics, etc.
- three key uses: describe (the world), decide (something), predict (something)
- key concepts:
  - **learning from data**: we let the data guide us
  - **aggregation**: we “summarize” raw data
  - **uncertainty**: we assess how well our raw data maps on to the summarization
  - **sampling**: we acknowledge that our data are samples from a population

# populations and samples



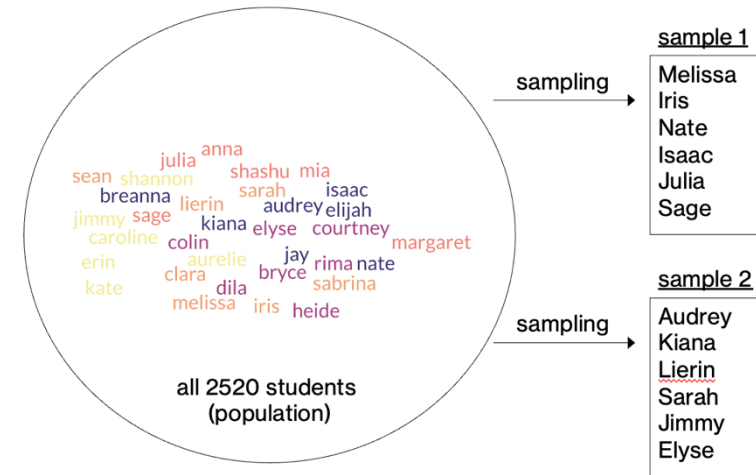
# populations and samples





# parameters, statistics, sampling error

- **parameter**: something that describes a **population**
- **statistic**: something that describes a **sample**
- **sampling error**: the **discrepancy** between the sample statistic and the true population parameter it is estimating
- to reduce sampling error:
  - use a sufficiently large sample
  - use random selection: selecting individuals from the population at random for your sample to create an unbiased sample



samples should be

- representative
- generalizable

# the scientific method

- the scientific method is a method for acquiring knowledge by making **predictions**, carrying out **experiments** to test those predictions, and making **inferences** based on the observed outcomes
- constructs, variables, and constants
  - **construct**: something intangible that we operationalize
  - **variable**: a characteristic that changes across conditions
  - **constant**: a characteristic that is fixed across conditions
- to make inferences, we **manipulate** a variable of interest, and observe the effect on an outcome variable, holding all other variables constant



# — samples in research

## experimental research

- test a manipulation to establish a **cause-and-effect relationship** between two variables

## non-experimental research

- **quasi-experimental** research
  - no actual manipulation, groups/variables defined due to natural variations
- **descriptive** research
  - single or collection of variables are observed and summarized
- **correlational** research
  - at least two variables are observed to determine a relationship

# research terminology: review

- independent variable (what is being manipulated?)
  - levels denote the types of “conditions” that a participant could be assigned to
- dependent variable (what is being measured?)
- design type (within- or between-subjects/participants)
  - were all participants exposed to all levels of the independent variable?
- key ideas for controlling other extraneous variables:
  - random assignment
  - matching/holding constant
  - control conditions

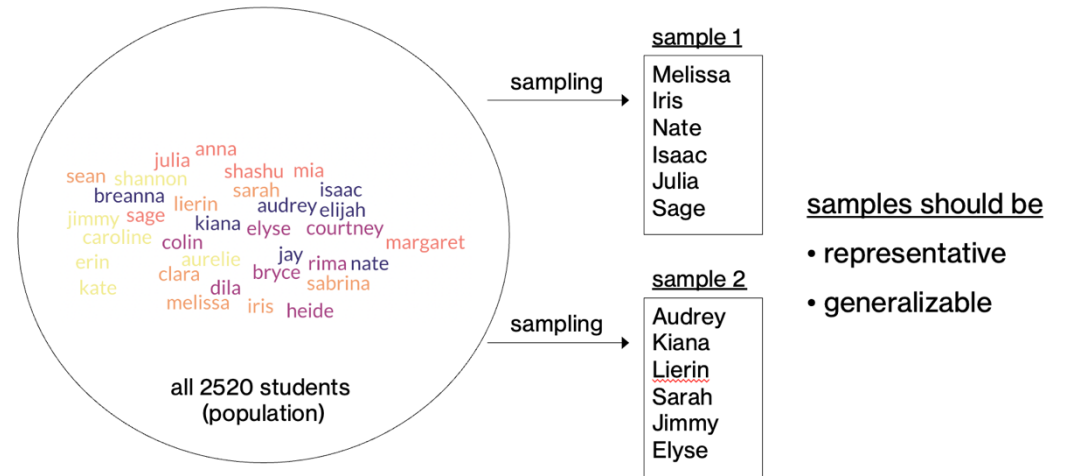
# practice scenario

- A clinical psychologist is interested in the effectiveness of a new anti-depression drug. He collects depression scores from a group of individuals diagnosed with depression at time 1. All individuals then take the drug, and are measured again a month later at time 2.
  - what kind of study is it (experimental / non-experimental)?
  - independent and dependent variables?
  - design type (within- or between-participant)?
  - what would the data look like? what would a plot of results look like?



# from samples to data

- samples provide us with information
- **data are** measurements or observations obtained from a sample
  - a **dataset** is a collection of measurements or observations
  - a **datum** is a single measurement or observation

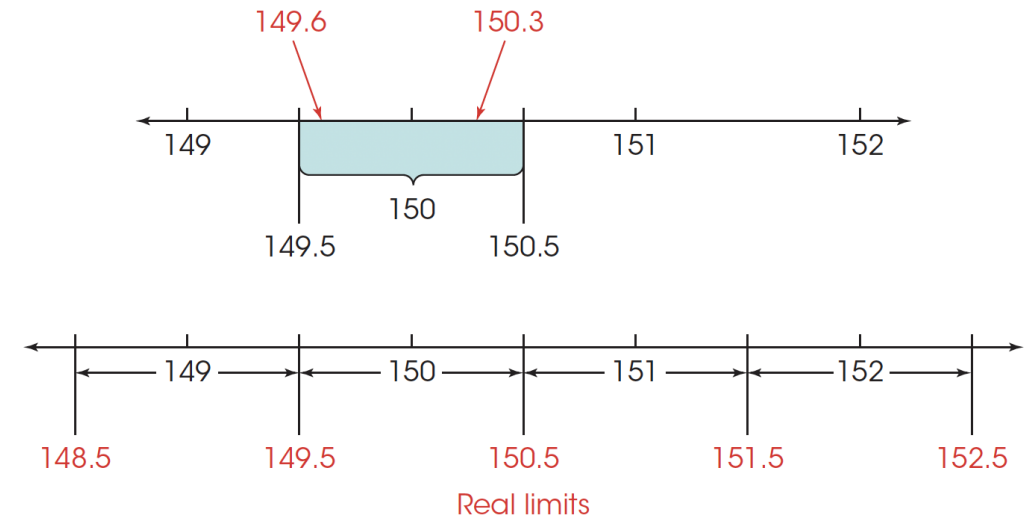


# scales of measurement

- data can be measured in several ways:
  - **qualitative** (put things into categories) vs. **quantitative** (assign numbers) data
  - **discrete**: separate, indivisible values. no values can exist between two neighboring values; integer scales
  - **continuous**: an infinite number of possible values fall between any two observed values. hypothetically divisible into an infinite number of fractional parts.
- how data are measured determines:
  - what kinds of mathematical operations can be applied
  - what kind of statistical computations can be computed

# real limits for continuous data

- only applies to continuous data
- the real limit separates two adjacent scores, and is located halfway between the scores
  - each score has an upper real limit (UL) and a lower real limit (LL)
- lower limit for 150 is 149.5; upper limit is 150.5



# scales of measurement

NOIR	<div>each value has a unique meaning</div> <div>a value has a sense of quantity, some values are larger, some are smaller</div> <div>units along the scale of measurement are equal to one another</div> <div>the scale has a true meaningful zero point</div>			
	identity	magnitude	equal intervals	absolute zero
<u>n</u> ominal				
<u>o</u> rdinal				
<u>i</u> nterval				
<u>r</u> atio				

# scales of measurement

NOIR	<div>each value has a unique meaning</div> <div>a value has a sense of quantity, some values are larger, some are smaller</div> <div>units along the scale of measurement are equal to one another</div> <div>the scale has a true meaningful zero point</div>			
	identity	magnitude	equal intervals	absolute zero
<u>n</u> ominal	✓			
<u>o</u> rdinal	✓	✓		
<u>i</u> nterval	✓	✓	✓	
<u>r</u> atio	✓	✓	✓	✓



# practice

- A researcher is testing the effect of alcohol on memory performance. He randomly gives one group of subjects a bottle of vodka, and another a nonalcoholic substance that tastes like vodka. Each group then learns a list of words, and attempts to recall them. Number of words correctly recalled for each group is recorded
  - what is the scale of the independent variable?
  - what is the scale of the dependent variable?

# activity

NOIR	each value has a unique meaning	a value has a sense of quantity, some values are larger, some are smaller	units along the scale of measurement are equal to one another	the scale has a true meaningful zero point
	identity	magnitude	equal intervals	absolute zero
nominal	✓			
ordinal	✓	✓		
interval	✓	✓	✓	
ratio	✓	✓	✓	✓

- assign a data type to each variable (NOIR) and whether it is discrete / continuous

variable	NOIR	discrete/continuous
numbers on basketball jerseys		
sizes of Starbucks orders		
weight		
calendar years		
IQ scores		

# activity

NOIR	each value has a unique meaning	a value has a sense of quantity, some values are larger, some are smaller	units along the scale of measurement are equal to one another	the scale has a true meaningful zero point
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- assign a data type to each variable (NOIR) and whether it is discrete / continuous

variable	NOIR	discrete/continuous
numbers on basketball jerseys	nominal	discrete
sizes of Starbucks orders	ordinal	discrete
weight	ratio	continuous
calendar years	interval	continuous
IQ scores	interval	continuous

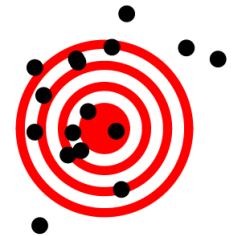
# reliability and validity

- **reliability**: consistency of measurements
  - test-retest reliability
  - inter-rater reliability
- **validity**: are we measuring what we think we are measuring?
  - **face** validity: reality check, does it make sense?
  - **construct** validity: is it related to other measurements in a logical manner? convergent vs. divergent validity
  - **predictive** validity: can it predict future data?

A: Reliable and valid



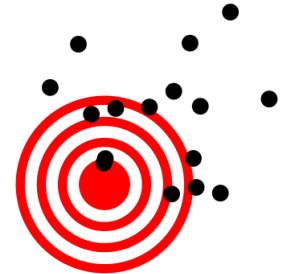
B: Unreliable but valid



C: Reliable but invalid



D: Unreliable and invalid



# next time



- why/how do we summarize data?
- how do we “explain” data?

## Prep



### Before Tuesday

- Watch: [Summarizing Data](#).
- Read Chapter 2 from the Gravetter & Wallnau (2017) textbook.

### Before Thursday

- Watch: [Central Tendencies](#).
- Read Chapter 3 from the Gravetter & Wallnau (2017) textbook.

### After Thursday

- See [Apply](#) section.

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# bonus practice: scenario

- A social psychologist is interested in gender differences in math performance. She randomly selects students from Bowdoin and has them solve a series of equations. Number of equations correctly solved for each participant is recorded.
  - what kind of study is it (experimental / non-experimental)?
  - independent and dependent variables?
  - design type (within- or between-participant)?
  - what would the data look like? what would a plot of results look like?

# **bonus practice: data in abstracts**

- table groups
- go to the [abstract document](#) and read over the abstract
- make note of (you will need to make a copy to edit the document):
  - independent variable(s) and data type(s)
  - dependent variable(s) and data type(s)
- predicted graph of results?
- key takeaway?