

Measuring the world



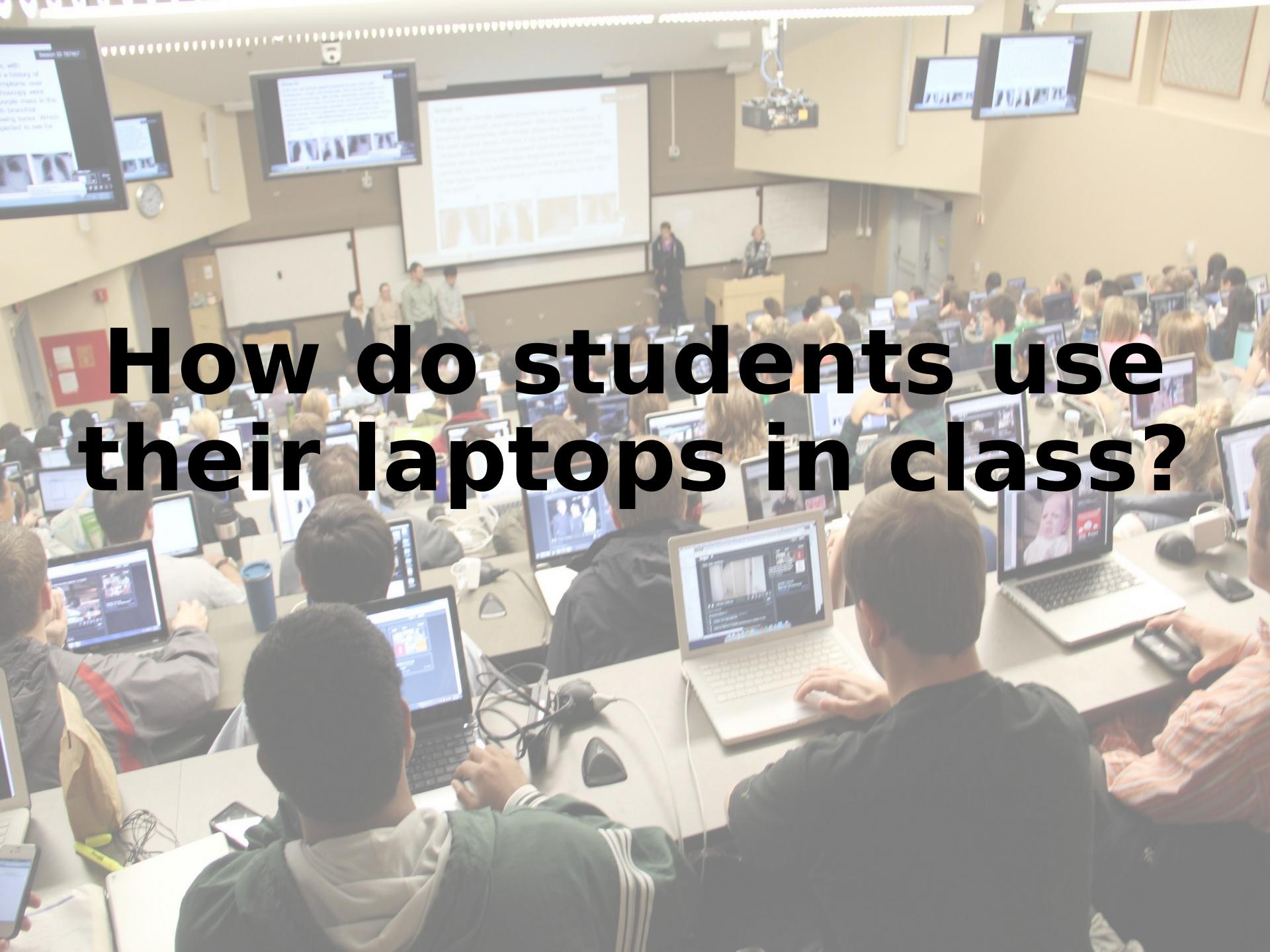
The goals of science

Description

Prediction

Explanation

Control

A classroom scene showing many students from behind, working on their laptops. In the background, a teacher stands at a podium. Several large screens on the wall display text and images related to the lesson.

How do students use their laptops in class?

What **population** are you interested in measuring?



Get a
representative
sample!

Population

- Set of all the individuals (N) of interest in a particular study
- Typically this concerns a *very large* group



Sample

- Set of individuals (n) selected from a population
- Intended to be representative of the population
- Varies in size (but bigger is better, ~~generally speaking~~)

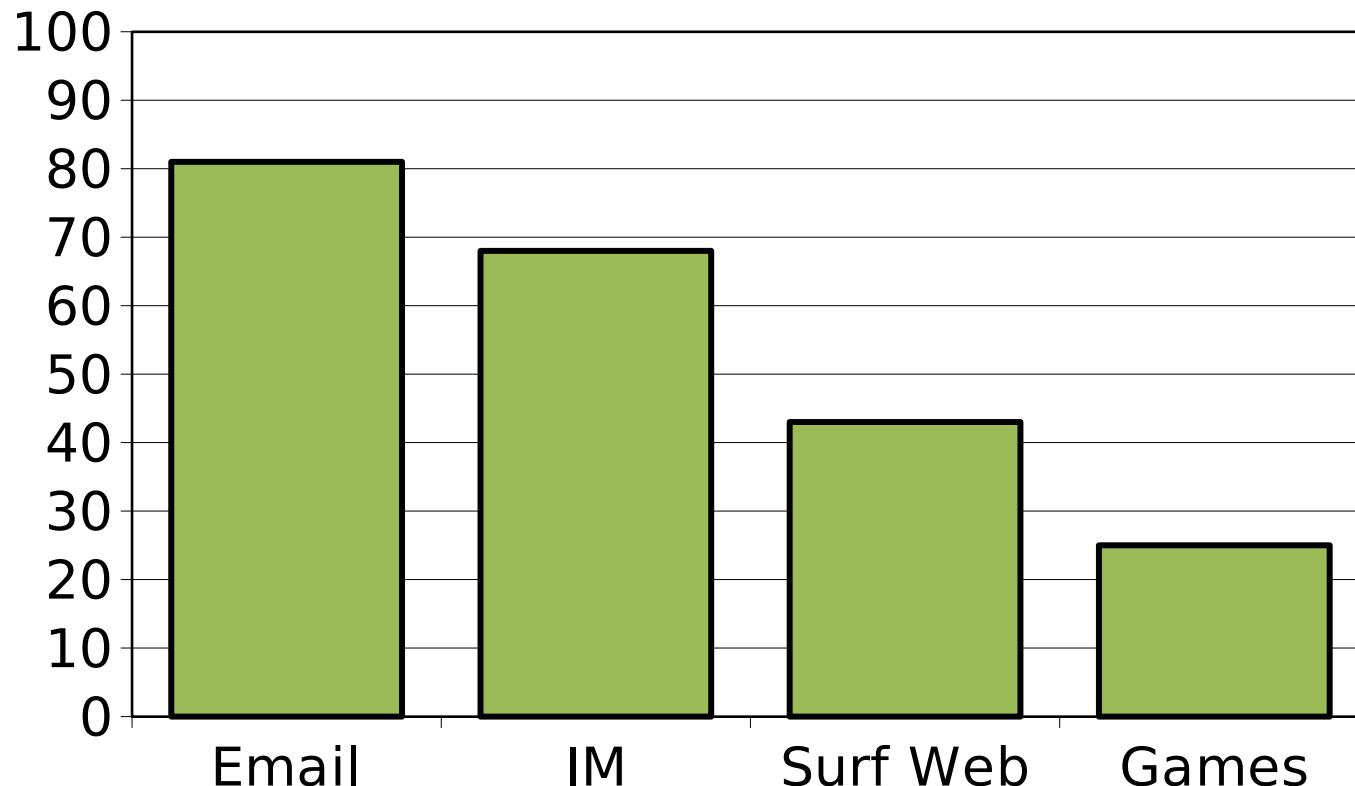


“Students in this class”

Population or Sample?

Sample: 137 students in a General Psych course at *Winona State University*, MN. About 64% used a laptop in at least 1 class. Of those students...

Percentage (%) of students who admit to using laptops in class to:



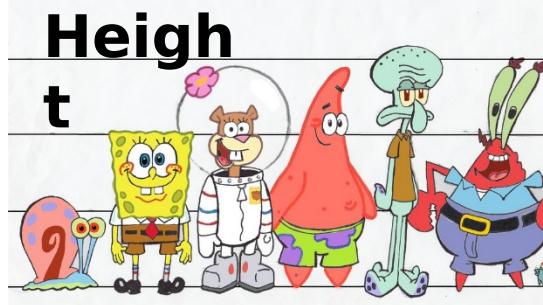
What Do We Measure?

Variable: Characteristics, attributes, or conditions that can take on different values (vary) or change and that can be measured in our sample

Temperatu



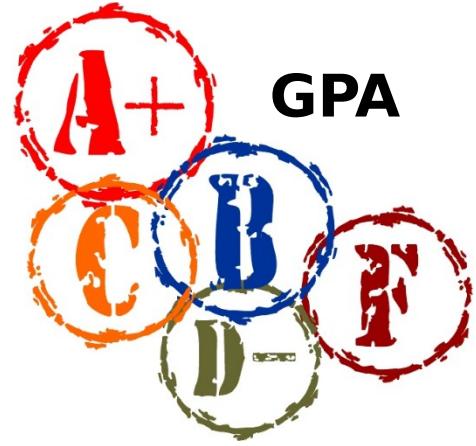
**Heigh
t**



Hair color



GPA



Types of variables

Categorical (discrete)



(Nominal, Ordinal)

Indivisible categories

Quantitative



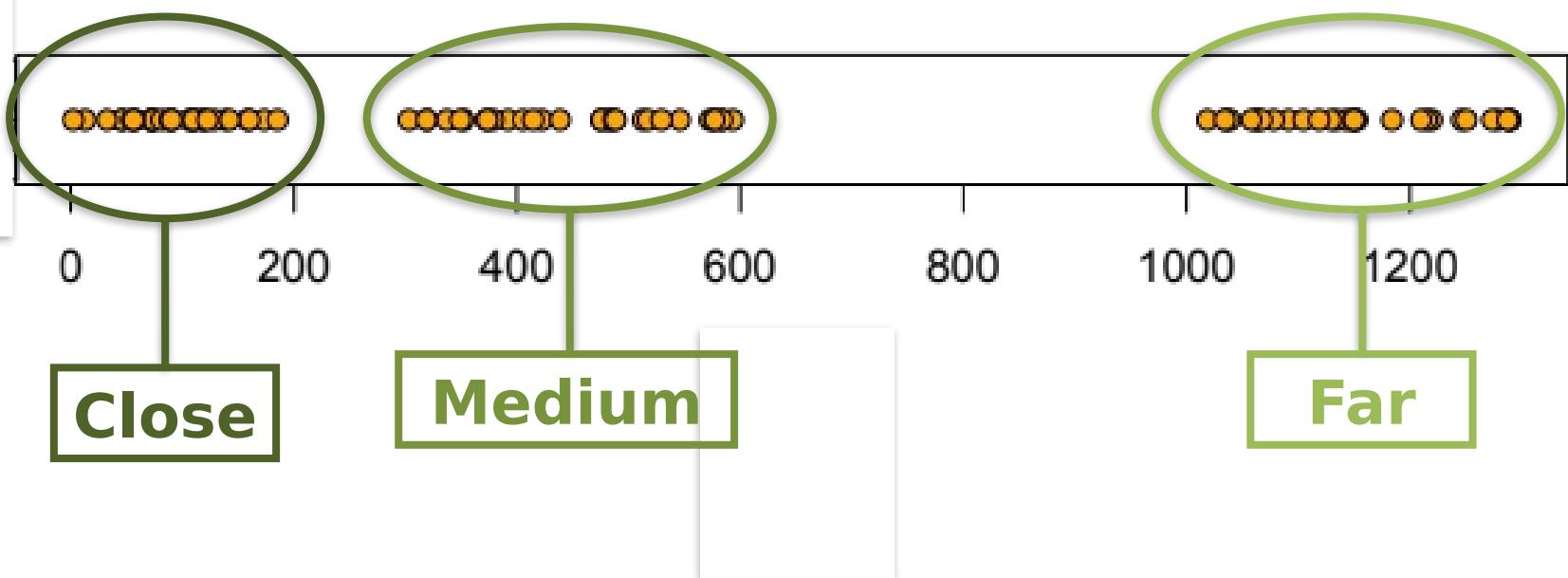
(Interval, Ratio)

Some are:

Continuous: (Infinitely) divisible categories

Converting **quantitative** to **categorical**

Miles Your Parents live from Purchase



Converting quantitative to categorical

Age

0 - 1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10 - 11 - 12 - 13 - 14 - 15 - 16 - 17 -
18 - 19 - 20

Infant - Toddler - Child - Pre-teen - Teenager -
Young Adult

Converting **categorical** to **quantitative?**



Scales of Measurement

Nominal
(categorical
)

Discrete factors that can only take on specific, mutually exclusive qualitative values

color; name,
political
party;

Ordinal
(categorical)

Categories organized in an ordered sequence terms of size or magnitude

Year in
school, 2 vs.
3 vs. 4 star
restaurants

Interval
(quantitative,
sometimes
continuous)

Interval: Ordered numeric categories that are all intervals of exactly the same size; arbitrary zero

IQ, degrees
Fahrenheit

Ratio
(quantitative,
continuous)

Ratio: Interval scale with an absolute zero point (absence of variable), meaningful ratios

Height;
weight;
reaction time

Scales of Measurement

Nominal: Label and categorize qualities of a variable with no quantitative distinctions

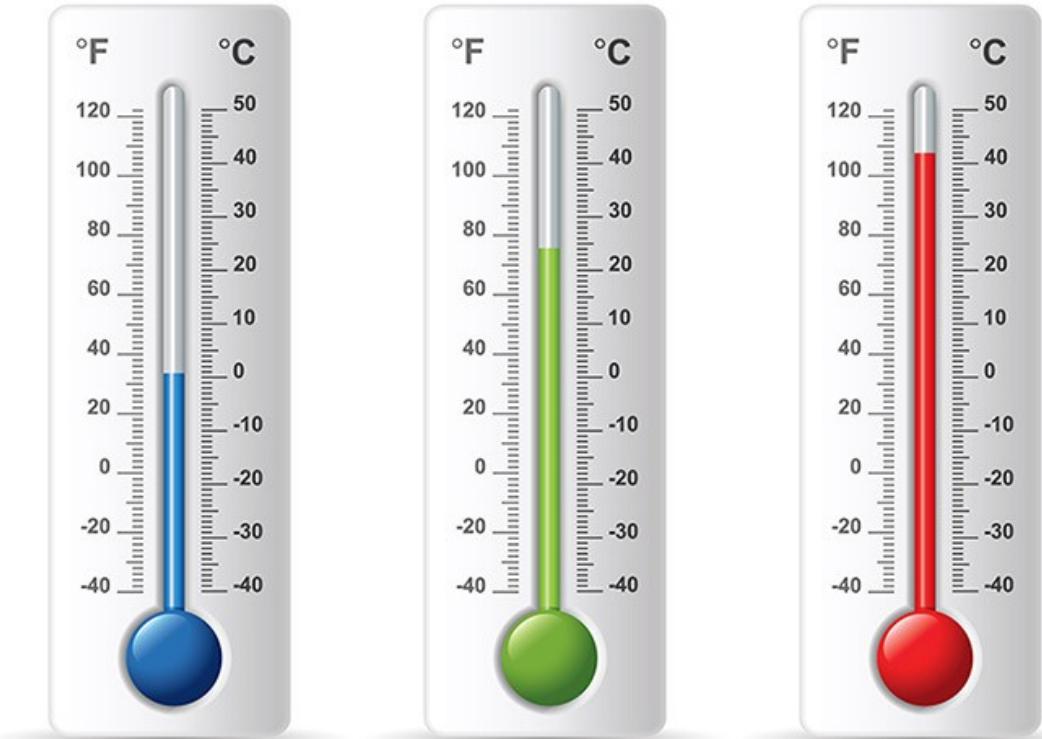
Example:

Thermometer color

Blue

Green

Red



Scales of Measurement

Ordinal: Categories organized in an ordered sequence in terms of size or magnitude

Example:

Cool

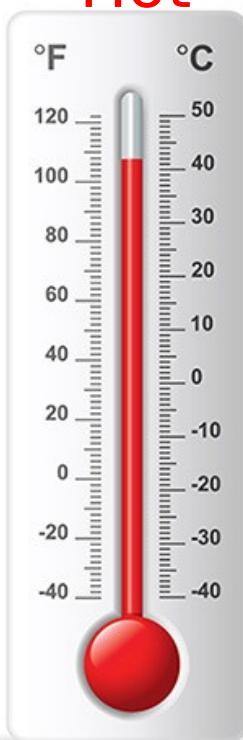
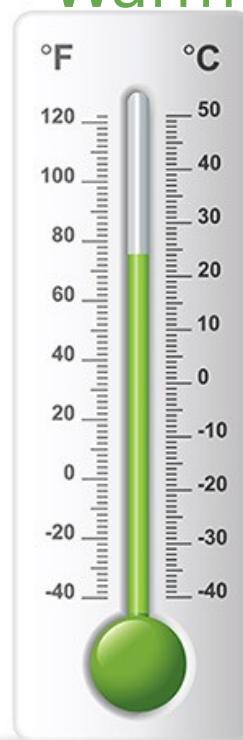
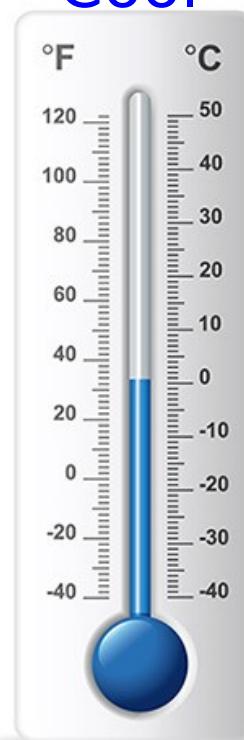
Warm

Hot

Cool

Warm

Hot

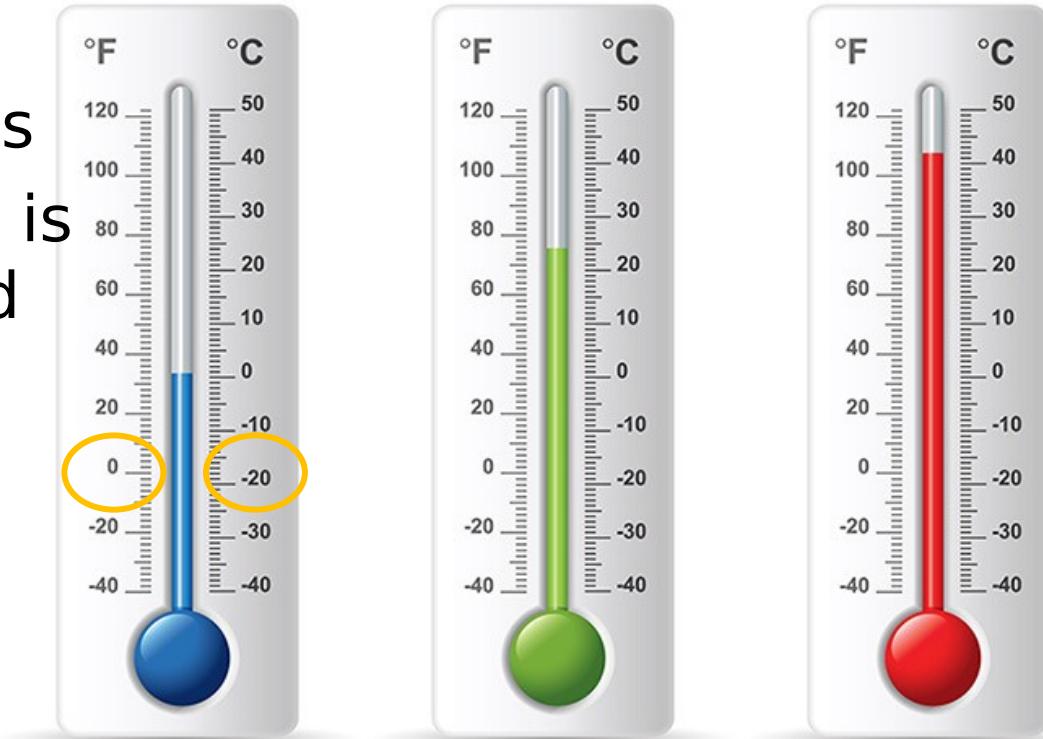


Scales of Measurement

Interval: Ordered categories that are all intervals of exactly the same size, **arbitrary zero**

Example:

0 degrees F provides
an indication that it is
probably pretty cold



Scales of Measurement

Ratio: An interval scale, but now has an absolute zero point, which indicates an absence of the variable.

Example:

A zero on a scale would indicate an absence of weight



Scales of Measurement in Action

VARIABLE	Nominal	Ordinal	Interval	Ratio
eye color				
number of siblings				
state where you were born				
did you eat breakfast this morning?				
did you vote in the last election?				
shoe size				
miles your parents live from Purchase				
total \$ (in cents) you have on you now				
college major				
Year in school (freshmen, sophomore...)				



**What Else Can We
Measure?**

Construct: an abstract attribute or characteristic that cannot be directly observed or measured but is thought to explain or predict behavior

Prejudice



Love

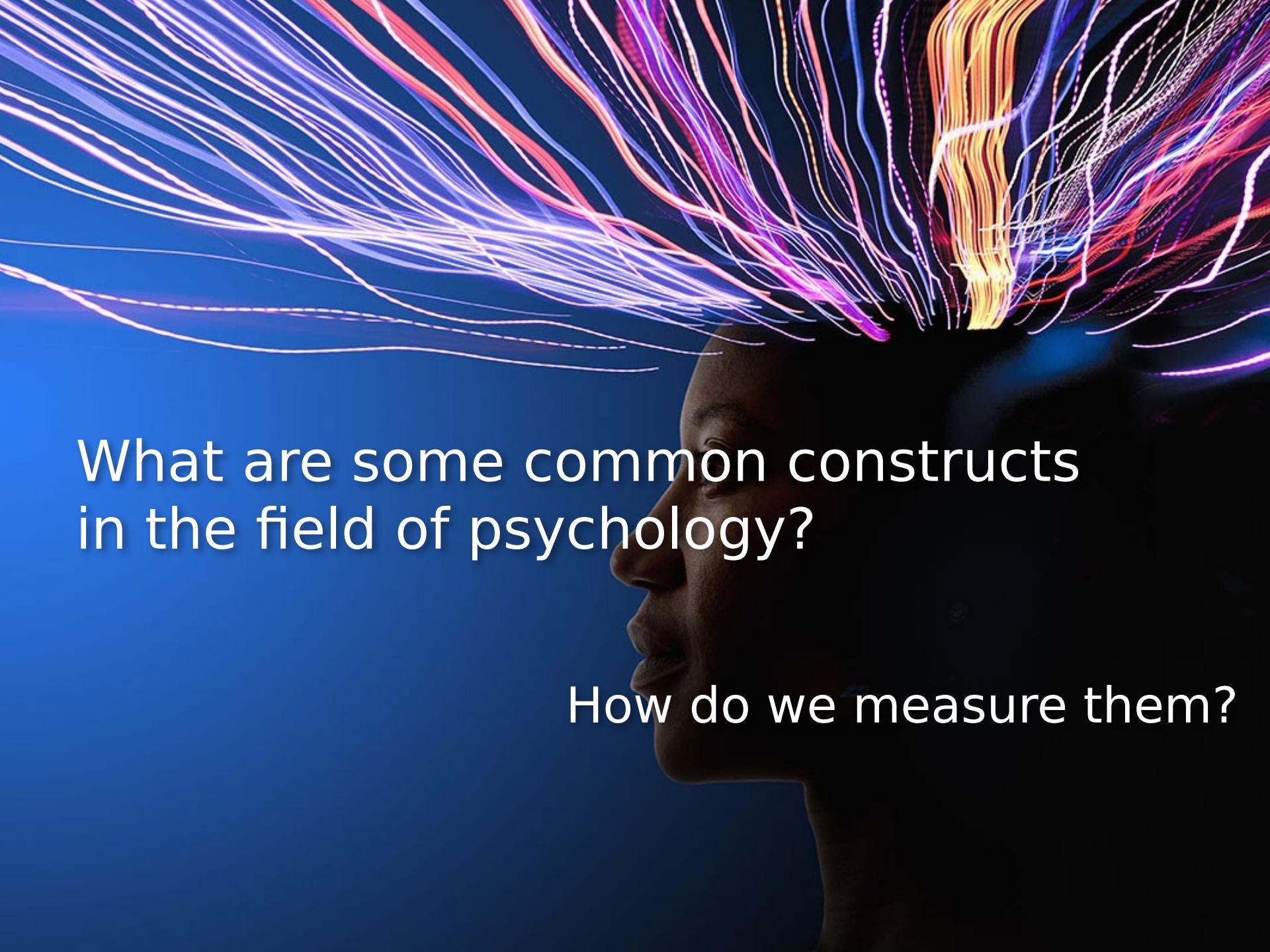


Anxiety



Constructs in Everyday Life

- Does he **like** me?
- Is she **mad** at me?
- Am I **smarter** than they are?
- Am I **successful**?
- Are these clothes **cool**?



What are some common constructs
in the field of psychology?

How do we measure them?

Operational Definition

A description of the construct of interest in terms of a specific procedure (set of operations) for measuring observable behavior (variable/s)

e.g. Happiness = Number of smiles per day



Operational Definition

Limitations to keep in mind:

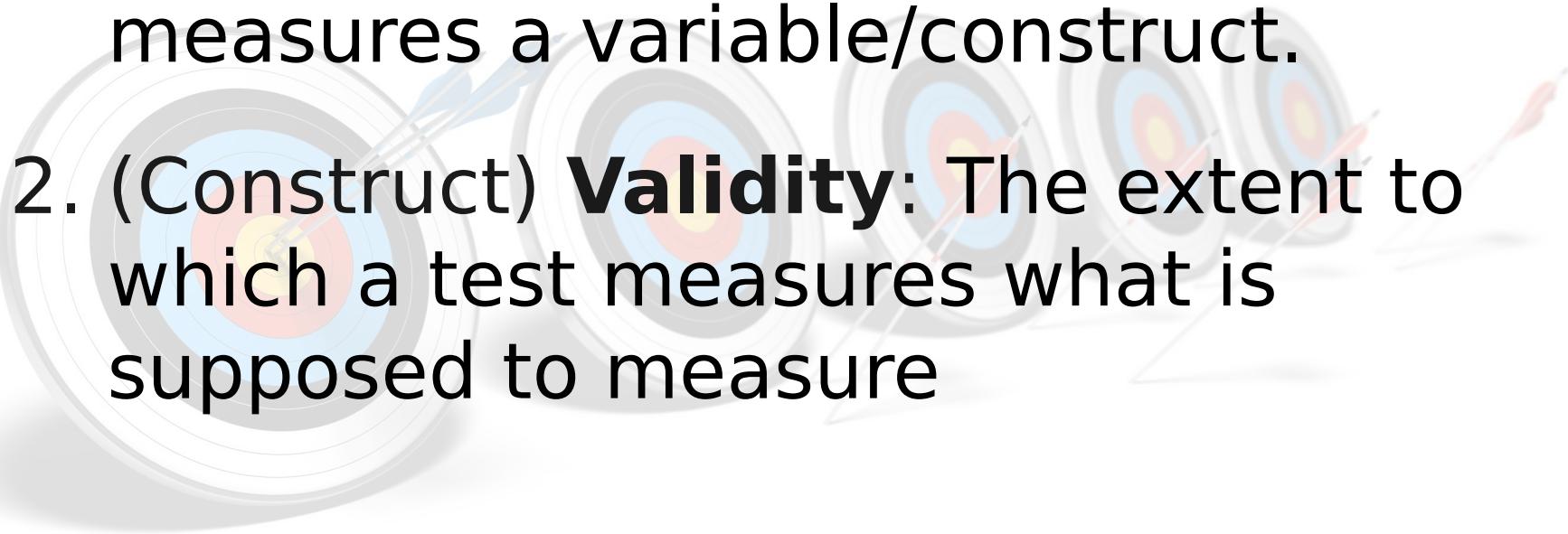
1. Operational definitions are usually oversimplifications
2. Often there is not a one-to-one relationship between the variable/construct of interest and the measurements obtained
3. Different methods may be used to measure the same variable/construct (i.e., different operational definitions), which may lead to different findings

How Do We Get Measurements?

Modes of Measurement in Psychology

Self-Report	<p>Participants describe or rate themselves on some measure</p> <p>e.g., happiness rating scale</p>	Direct, easy, but subjective and could be biased or inaccurate
Physiological	<p>Measure some aspect of the body or brain</p> <p>e.g., blood pressure, EEG</p>	Objective, but difficult to obtain, hard to relate to constructs
Behavioral	<p>Measure some aspect of observable behavior</p> <p>e.g., Reaction time, # smiles</p>	Somewhat objective, but can be influenced by situational

Key Qualities in a Measure

- 
- 1. Reliability:** The degree of consistency with which a test measures a variable/construct.
 - 2. (Construct) Validity:** The extent to which a test measures what is supposed to measure

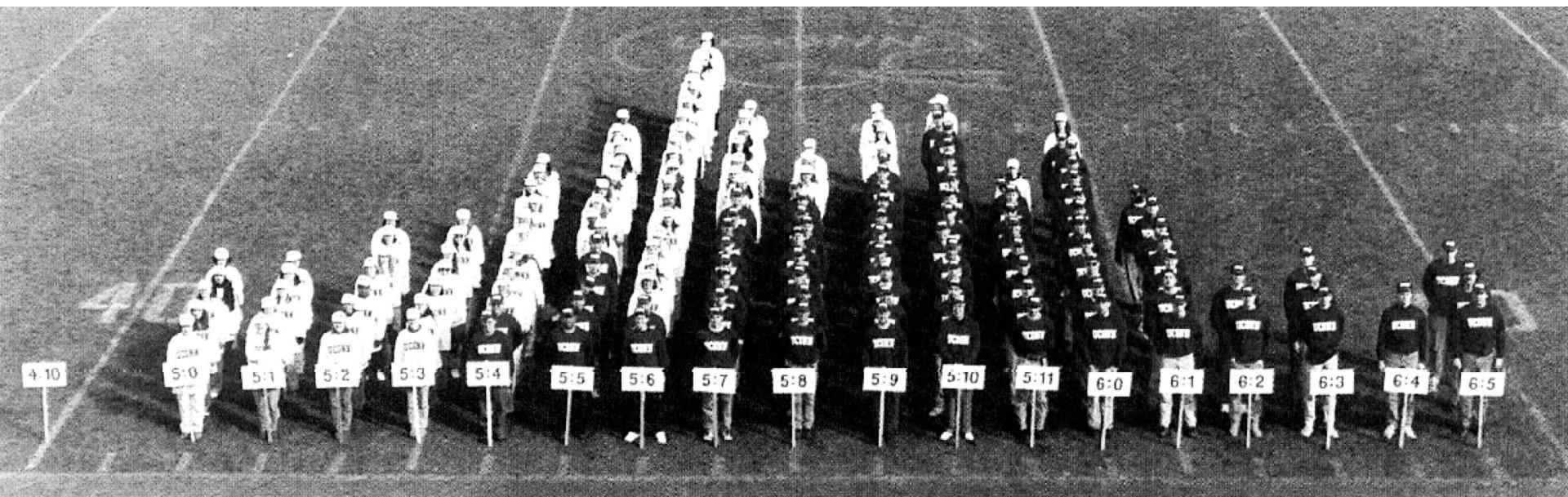
Collecting, Entering, and Getting to Know your Data

How to Describe Data?

\$0.00	\$2.07	\$2.00	\$1.50	\$0.00	\$0.90	8.97	5720.79	6.47	16.52	14.21	30.73	33.69	\$1,010.80
\$2.50	\$3.77	\$2.50	\$1.00	\$1.40	\$0.00	15.17	5735.96	11.2	17.00	14.02	31.02	32.55	\$976.43
\$1.50	\$9.07	\$3.50	\$0.00	\$0.70	\$0.30	33.07	5768.73	15.1	17.65	14.09	31.74	33.15	\$994.37
\$9.00	\$10.47	\$0.50	\$1.50	\$1.40	\$0.00	46.87	5815.60	22.9	18.14	14.38	32.52	34.08	\$1,022.43
\$2.50	\$4.44	\$2.00	\$1.50	\$3.15	\$0.00	33.84	5849.44	13.6	17.49	14.39	31.88	33.58	\$1,007.52
\$5.50	\$13.72	\$1.50	\$0.50	\$4.20	\$0.90	44.57	5893.11	26.3	17.76	14.34	32.10	33.45	\$1,003.55
\$2.00	\$4.72	\$2.50	\$0.00	\$1.05	\$0.00	37.27	5930.38	10.3	16.40	15.13	31.52	33.09	\$992.62
\$2.00	\$1.56	\$0.00	\$0.00	\$0.35	\$0.60	10.51	5940.29	4.51	16.16	15.23	31.39	31.51	\$945.38
\$1.00	\$4.00	\$0.00	\$1.00	\$1.05	\$0.00	14.05	5954.34	7.05	16.08	15.27	31.35	29.91	\$897.27
\$3.50	\$13.42	\$7.50	\$0.50	\$0.70	\$0.30	48.07	6002.11	25.9	16.85	15.71	32.56	31.06	\$931.67
\$8.00	\$8.23	\$4.00	\$2.50	\$1.05	\$0.00	42.68	6044.79	23.8	17.44	15.65	33.09	32.04	\$961.09
\$4.00	\$7.90	\$2.00	\$1.25	\$1.20	\$0.00	43.95	6088.44	19.7	17.12	16.17	33.28	32.28	\$968.37
\$3.00	\$6.78	\$2.0	\$1.0	\$0.0	\$0.0	40.01	6101.01	15.0	16.04	32.2	31.8	31.8	\$970.29
\$2.00	\$6.20	\$1.50	\$1.50	\$0.70	\$0.00	36.50	6169.57	11.9	15.31	17.55	32.87	31.79	\$953.70
\$1.00	\$1.26	\$0.00	\$0.25	\$0.35	\$0.00	10.96	6180.53	2.86	15.06	17.95	33.01	30.95	\$928.44
\$0.00	\$3.83	\$1.50	\$2.00	\$1.40	\$0.90	18.63	6198.26	9.63	14.95	18.31	33.26	30.91	\$927.25
\$8.50	\$9.74	\$3.00	\$0.00	\$1.40	\$0.00	42.44	6240.70	22.6	15.49	18.44	33.93	31.78	\$953.46
\$3.50	\$9.17	\$2.00	\$1.50	\$1.40	\$1.20	41.87	6281.37	18.8	15.19	18.38	33.57	32.81	\$984.22
\$3.00	\$9.73	\$5.50	\$0.50	\$5.25	\$0.00	49.78	6331.15	24	15.94	18.77	34.71	33.70	\$1,011.02
\$4.00	\$11.00	\$3.00	\$2.00	\$21.00	\$0.00	72.20	6403.35	41	16.99	19.70	36.68	34.91	\$1,047.20
\$1.00	\$7.12	\$1.00	\$1.50	\$3.50	\$0.00	40.52	6443.87	14.1	17.26	19.65	36.91	34.83	\$1,044.93

Descriptive statistics

Tools for organizing, summarizing, and communicating a set of data



Step 1 looking at and describing results

FREQUENCY DISTRIBUTIONS

What is a frequency distribution?

An organized tabulation of the number of individuals located in each category on a scale of measurement

Frequency Distribution Table

Quiz Scores

1, 2, 3, 5,
4, 4, 2, 3,
1, 3, 2, 3,
2, 2



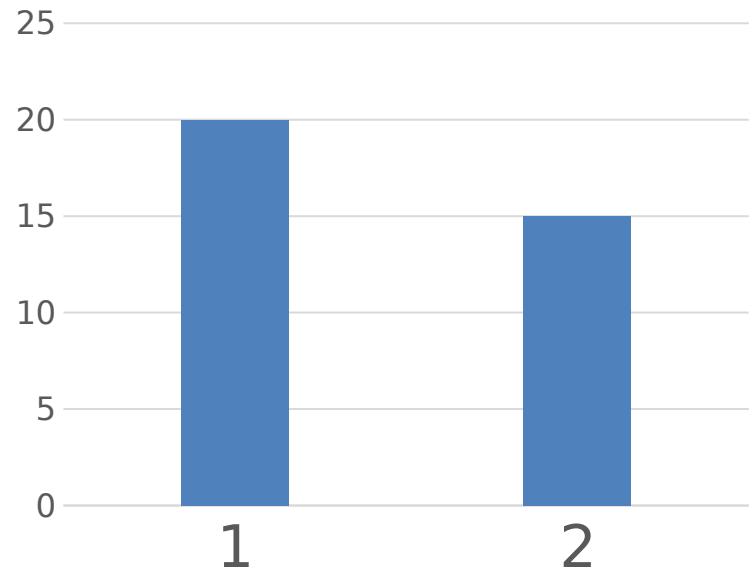
Score	Frequency
1	2
2	5
3	4
4	2
5	1

Frequency data

Frequency table – visual depiction of data that shows how many scores were in each category

Superhero	frequency
Wonder Woman	20
Superman	15

Frequency plot – visual depiction of data that shows how many (or what percentage of) scores were in each category.



Frequency Tables in JASP

“Percent” (%) =
Frequency/total

AKA “proportion” or
“relative frequency”

Frequencies for Fate

	Frequency	Percent	Valid Percent	Cumulative Percent
Banishment	5	11.6	11.6	11.6
Death	20	46.5	46.5	58.1
Imprisonment	7	16.3	16.3	74.4
Man vs Nature	1	2.3	2.3	76.7
Man vs Self	2	4.7	4.7	81.4
Man vs Society	5	11.6	11.6	93.0
Thwarted	3	7.0	7.0	100.0
Total	43	100.0	100.0	

Grouped frequency data

Grouped frequency distribution – Displaying a count or proportion for *groups* of possible values of a variable (i.e. putting continuous values into separate categorical or ordinal bins/intervals)

Grouped frequency table – a visual depiction of data that reports the frequencies within a given interval rather than the frequencies for a specific value

Rating range	frequency
0-25	4
26-50	1
51-75	5
76-100	6

Why did I choose to break this data into four groups?

What information is lost?

How much do you like The Hub?

(0 = worst food ever, 100 = best food ever)

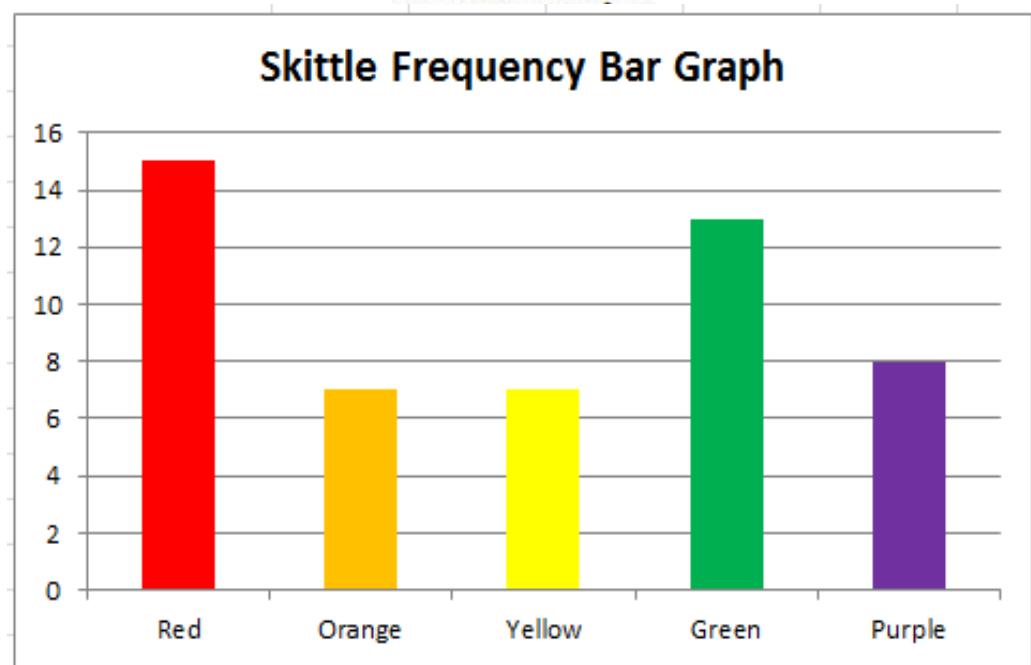
- What type of data is this?
(categorical, continuous...)
- **Raw Data:** 82, 23, 7, 99,
82, 65, 43, 55, 59, 76, 65,
65, 91, 100, 7, 5...
- How useful is this
frequency table?

Value	Frequenc y
5	1
7	2
23	1
43	1
55	1
59	1
65	3
76	1
82	2
91	1
99	1
100	1

Graphing Frequency Distributions

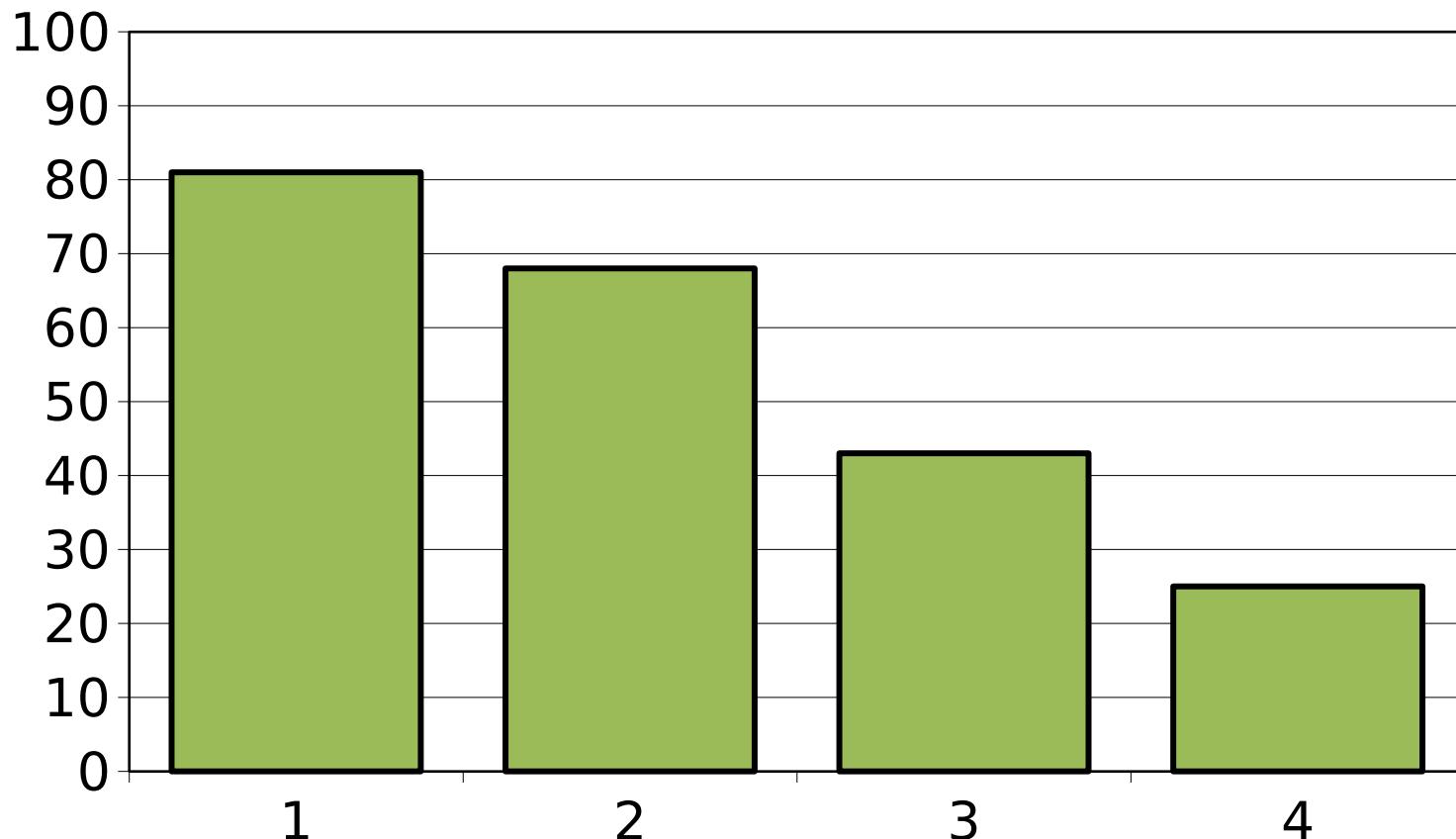
Bar Graphs

Separate and distinct bar used for each piece of information (frequency on y-axis). For nominal or ordinal data



Bar Graph of *Relative Frequencies*

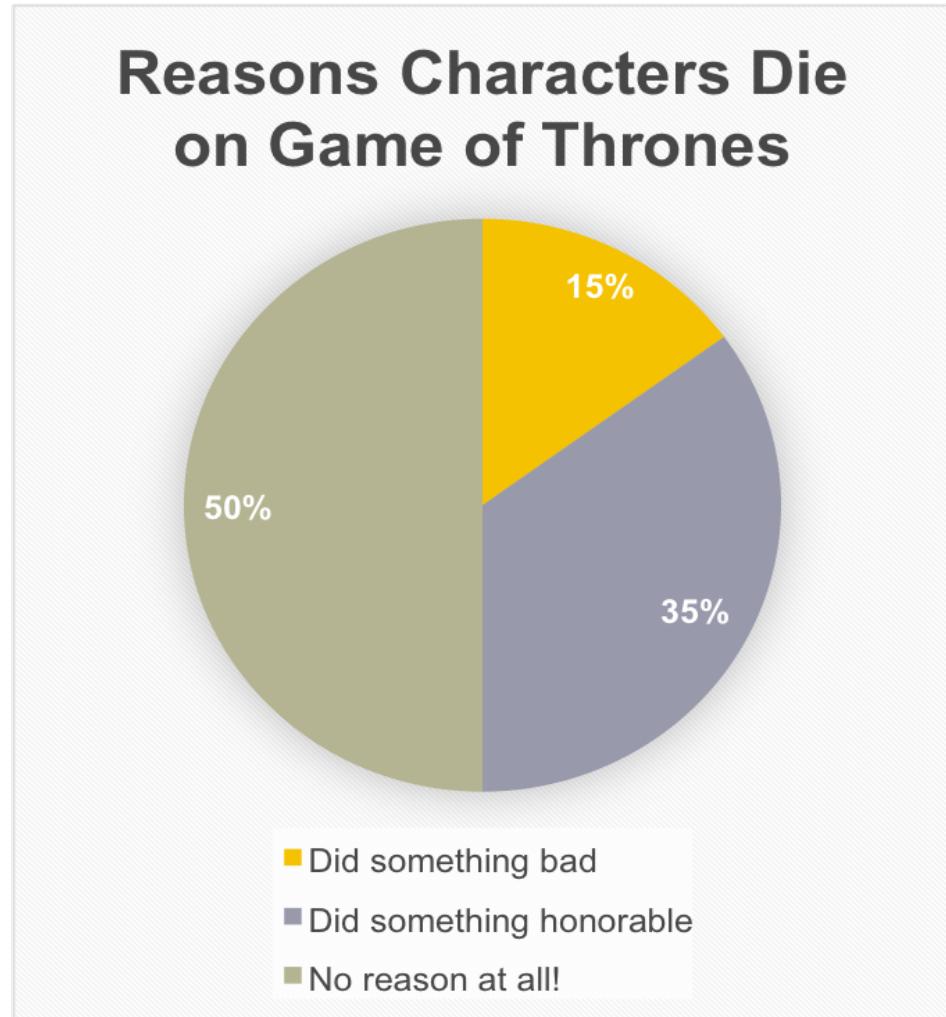
Percentage of students who admit to using laptops in class to:



Graphing (relative) Frequency Distributions

Pie Charts

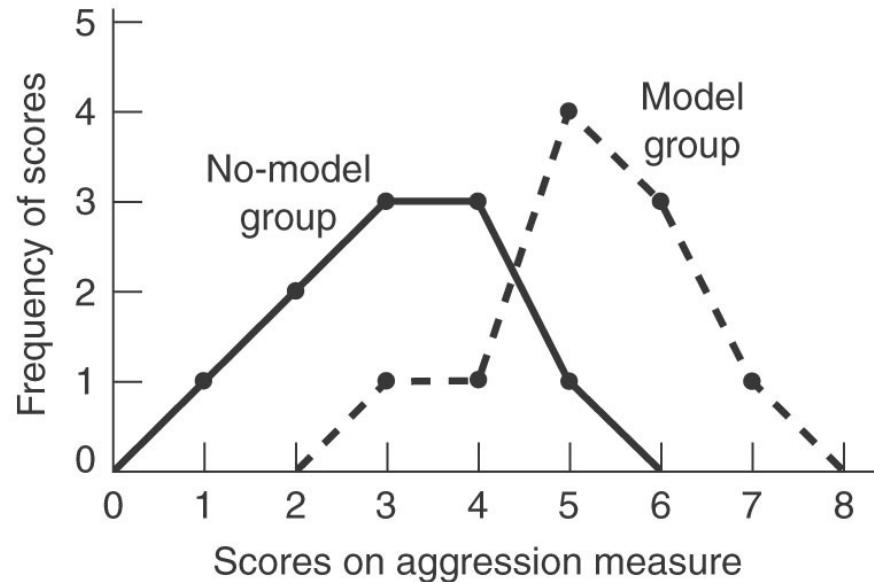
Circle is divided into “slices” that represent relative percentages



Graphing Frequency Distributions

Frequency Polygons

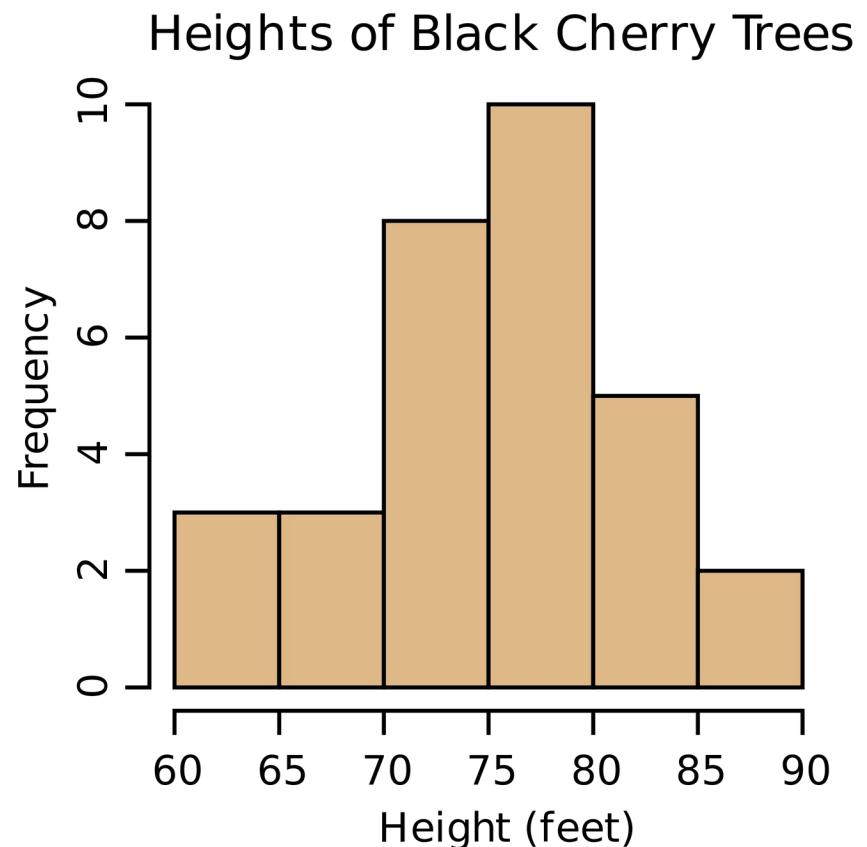
Vertical position of dot indicates a score's frequency. Continuous line is drawn between series of dots. Most useful for continuous variables



Graphing (grouped) Frequency Distributions

Histograms

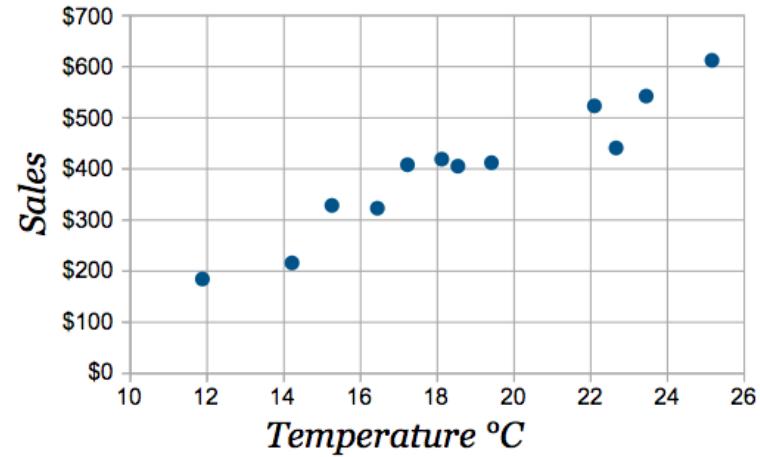
Uses bars to display (usually grouped) frequency distribution for a continuous (quantitative) variable



Graphing Other Information...

Scatterplot

Each dot shows an individual data point's value for each of the *two* measured continuous variables (useful for correlational research)



Line Graph

A series of data points, connected by lines, showing values at different levels of a (continuous or ordinal) variable

