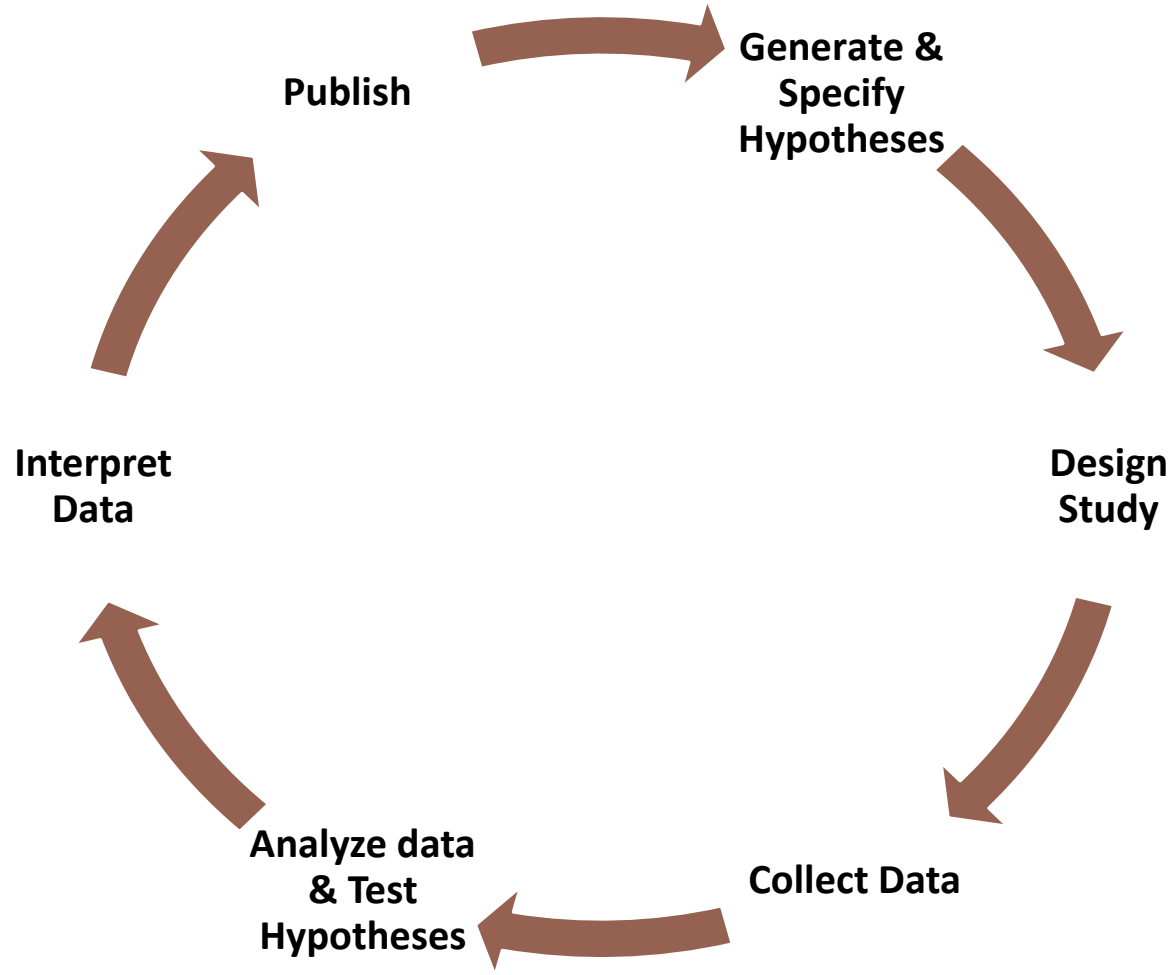
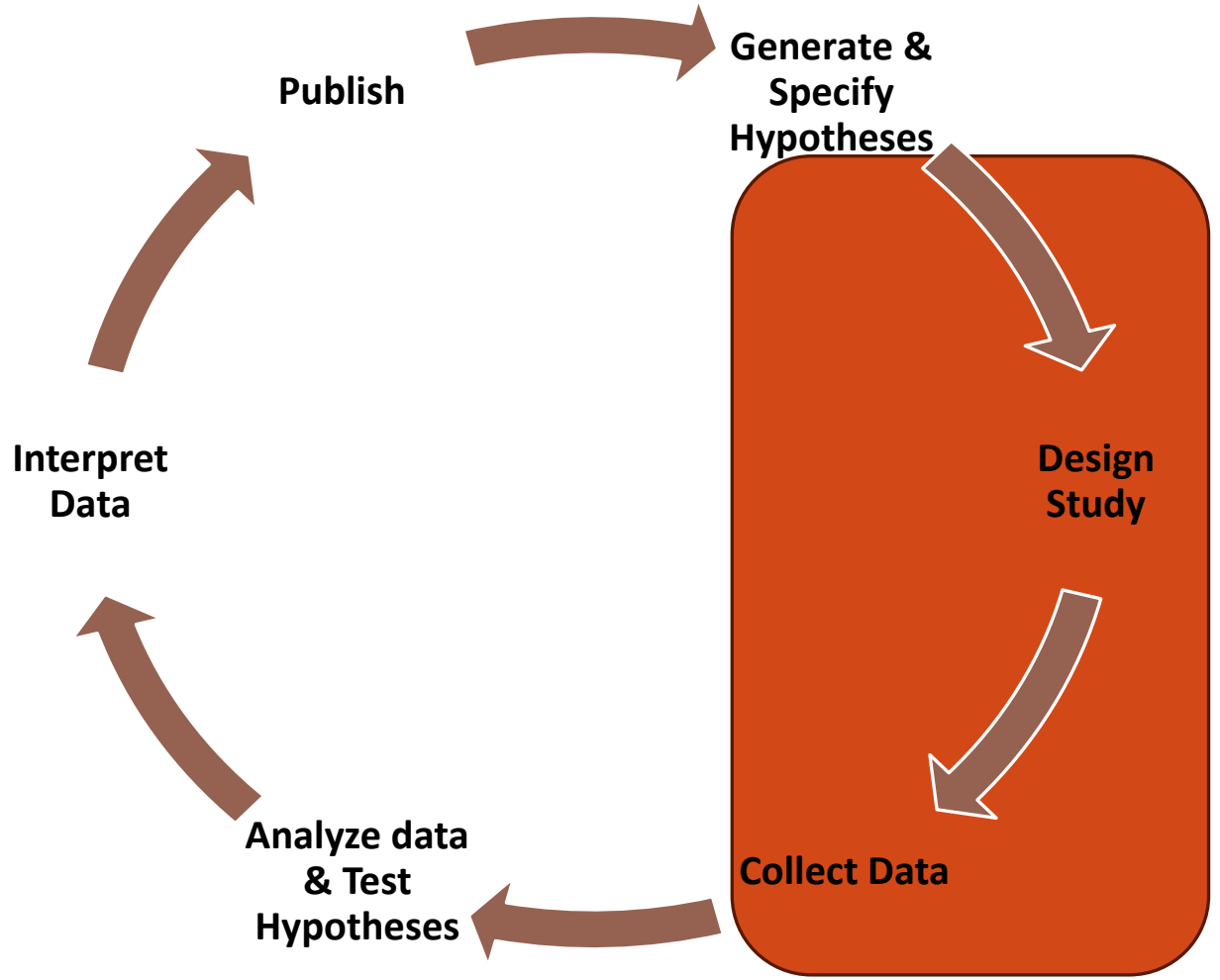
PSYC 640
Grad Stats

Research Design & Data

FALL 2023



Research Design



Research Design

Collect Data - Measurement

Data: information gained from observation or experimentation

Must be **measurable**

- Must be able to assign numbers, or labels, or some other kind of defined description to “stuff”

What ***aren’t*** examples of data? Can you make it measurable?

Measurement

Let’s measure age!

How would you answer to a question in a survey that asked:

How old are you?	

What might be some other responses?

Measurement

Let’s measure age!

How would you answer to a question in a survey that asked:

How old are you?	

What might be some other responses?

Would these other responses mean much to your study?

- What if you are concerned about young kiddos?
- What about those born premature?
- Do you require specificity in your measurement?

Operationalization

The process by which we take a concept and turn it into a precise measurement

When operationalizing a concept it is important to consider:

- Being precise about what we are trying to measure. *What do we mean when we ask about "age"?*
- Identifying the method you will use to measure. *Self-report? Caregiver report? Official Records?*
- Defining and setting the allowable values that your measurement can take
  - Is age numerical? Years? Months? What are the lower/upper bounds?
  - Gender and sex assigned at birth?

There is no single way to do it "correctly" (but probably some ways that you could do it incorrectly)

If operationalization isn't done well in the beginning, processing the data will take longer

Collecting Data - Variable

What we have when we use the measure to “observe” something in the world

The actual “data” that we end up in our files

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The actual “data” that we end up in our files

Scales of Measurement

Not all variables are created equally

Nominal Scale (or categorical variable)

- No relationship between the construct and the numbers

Transportation	Number of people
(1) Train	12
(2) Bus	30
(3) Car	48
(4) Bicycle	10

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(1) Train	12
(2) Bus	30
(3) Car	48
(4) Bicycle	10

What is the average transportation type?

Scales of Measurement

Ordinal Scale

- Slightly more structure than nominal scales
- There is an *order* to the answer choices (1 > 2 > 3 > 4), but the sequence of numbers is likely meaningless
- Can often *group* individuals

Please rate which statement most closely matches your beliefs.	Rating
Statistics is important and is essential to all humankind	1
Statistics is important and is essential to research	2
Statistics is important, but only in specific instances	3
Statistics is not important	4

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Statistics is not important	4

Average score is 2.839

Scales of Measurement

Interval Scale

- Numerical value has inherent meaning
- No “natural” zero
- Addition/subtraction apply (temperature)

Ratio Scale

- Numerical value has meaning
- There is a true 0
- Can also multiply/divide (Reaction Time)

Measurement Scales

		Nominal	Ordinal	Interval	Ratio
Number Meaning		Categories	Order	Equal intervals between characteristic	Equal intervals with true zero point
Arithmetic Operations	Inequality	x	x	x	x
	Ordering / Ranking		x	x	x
	Addition / Subtraction			x	x
	Multiplication / Division				x
Descriptive Statistics	Mode	x	x	x	x
	Median		x	x	x
	Mean			x	x
	Standard Deviation			x	x
Statistical Analysis Techniques Commonly Used	Crosstabs / Chi-Square	x	x		
	Rank Order Correlation		x		
	Analysis of Variance (NP)	x	x		
	Correlation			x	x
	Regression			x	x
	Analysis of Variance			x	x
	Factor Analysis			x	x

But what if it doesn’t work like that…

Complexities – Likert Scale

Which of the following best describes your opinion on the statement that “David Tennant is the best Doctor”…

1. Strongly Disagree
2. Disagree
3. Neither Agree not disagree
4. Agree
5. Strongly Agree

Complexities – Likert Scale

Which of the following best describes your opinion on the statement that “David Tennant is the best Doctor”…

Strongly Disagree				Strongly Agree
1	2	3	4	5

Complexities – Likert Scale

They are EVERYWHERE!

Are they ordinal or interval?

- Define differences between 1-2 is the same as 3-4
- We tend to understand the differences

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3. Neither Agree not disagree
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Complexities – Likert Scale

They are EVERYWHERE!

Are they ordinal or interval?

- Define differences between 1-2 is the same as 3-4
- We tend to understand the differences

Average score is 3.42

1. Strongly Disagree
2. Disagree
3. Neither Agree not disagree
4. Agree
5. Strongly Agree

Quasi-interval scale

Is the measurement any good?

Validity: how *accurate* we are measuring the construct

- Is it *actually* measuring what we want it to?

Reliability: how *precisely* it is that we are measuring the construct

- Can we repeat the measure? Is it going to be consistent?

<u>Types of reliability</u>

- Test-retest
  - Consistency over time
- Inter-rater
  - Consistency between people
- Parallel forms
  - Consistency across measurements that should be related
- Internal consistency
  - All components are consistent with each other within a measure

Types of Research

BASIC

Goal: Understand fundamental psychological phenomenon

Example: Factors that impact our attributions about events

APPLIED

Goal: Shed light on real world problems (e.g., *find solutions, see how phenomena apply in specific contexts)*

Example: How do the fundamental attributions impact the transition to graduate school?

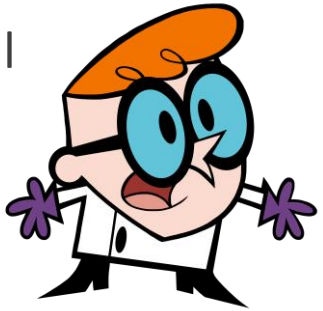
Types of Research - Settings

LABORATORY

May be higher in **internal validity – Why?**

- Can more closely control context
- *Higher experimental realism* (how much participants are impacted by the study itself)
- Tradeoff: lower ecological validity (mundane realism)

Experimental



FIELD

May be higher in **external validity – Why?**

- More realistic – meeting people "where they are"
- *Higher mundane realism*
- Tradeoff: potentially lower internal validity?

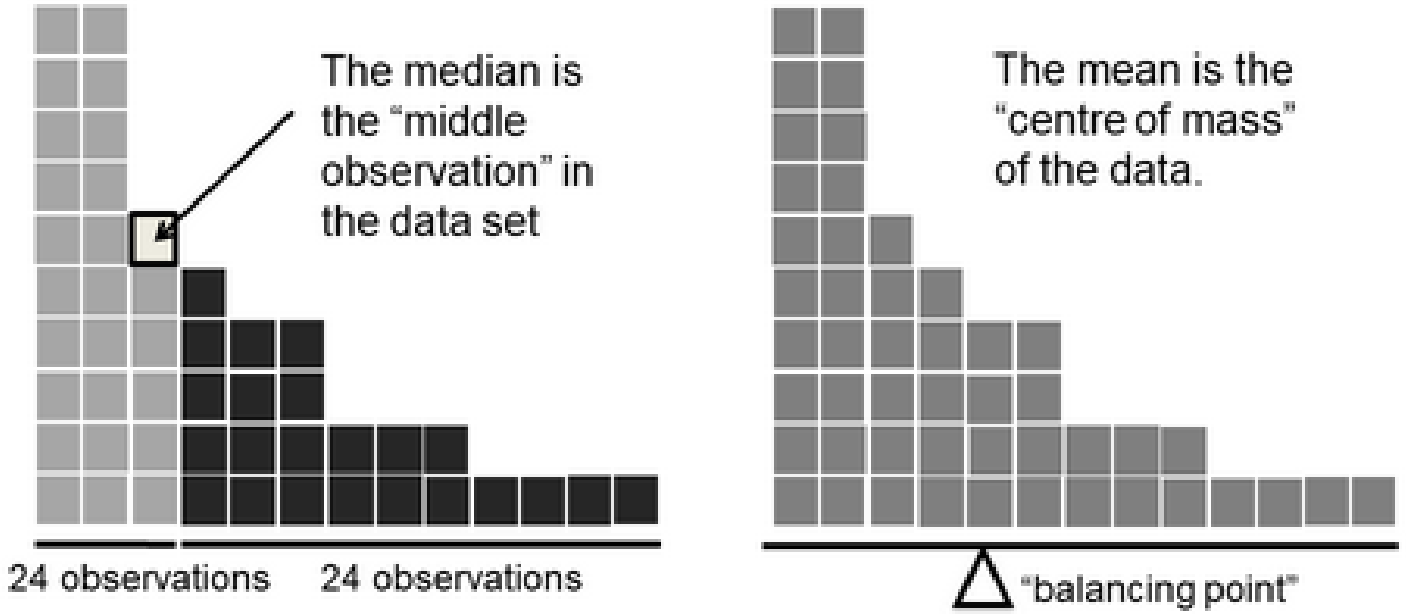
Non-Experimental


Data

Descriptive Statistics

Central Tendency – *What is the middle/popular?*

- Mean, Median, Mode



Mean

The *sample mean*, denoted as $\bar{x}$, can be calculated as

$$\bar{x} = \frac{x_1 + x_2 + \cdots + x_n}{n},$$

where x_1, x_2, ..., x_n represent the *n* observed values.

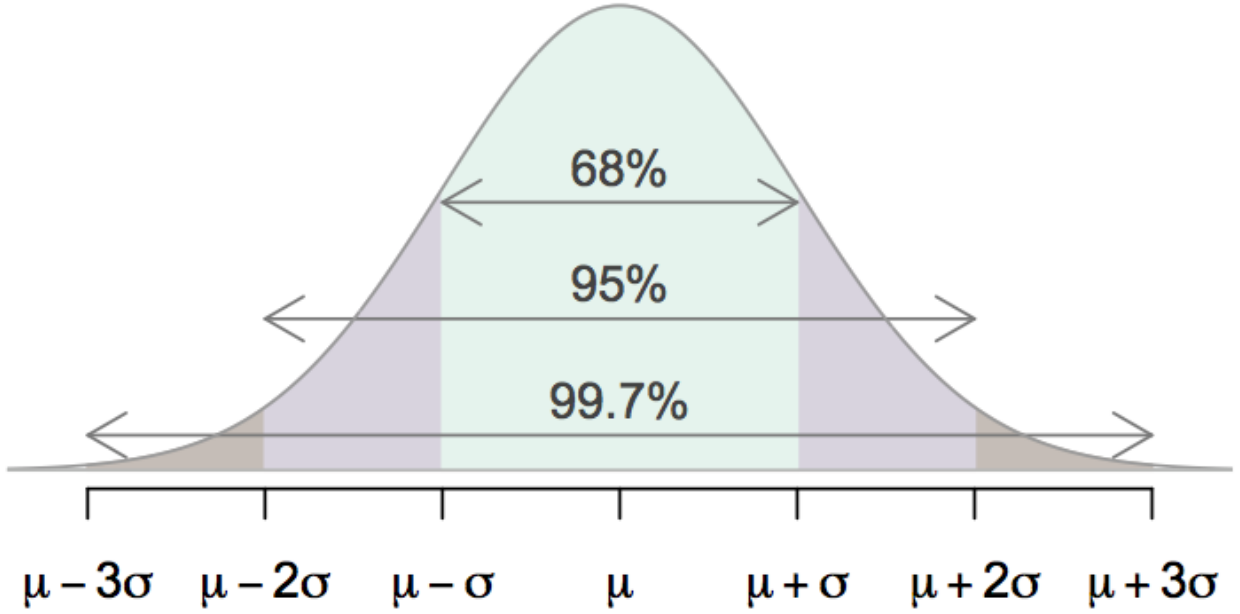
The *population mean* is also computed the same way but is denoted as μ. It is often not possible to calculate μ since population data are rarely available.

The sample mean is a *sample statistic*, and serves as a *point estimate* of the population mean. This estimate may not be perfect, but if the sample is good (representative of the population), it is usually a pretty good estimate.

Descriptive Statistics

Variability – *Spread of data; How far from middle?*

- Range, Variance, Standard Deviation



Descriptive Statistics

Variability – *Spread of data; How far from middle?*

- Range, Variance, Standard Deviation

68-95-99.7 Rule

- For nearly normally distributed data:
  - about 68% falls within 1 SD of the mean,
  - about 95% falls within 2 SD of the mean,
  - about 99.7% falls within 3 SD of the mean.
- It is possible for observations to fall 4, 5, or more standard deviations away from the mean, but these occurrences are very rare if the data are nearly normal.

Variance

$$\frac{1}{N-1}\sum_{i=1}^{N}(X_i-\bar{X})^2$$

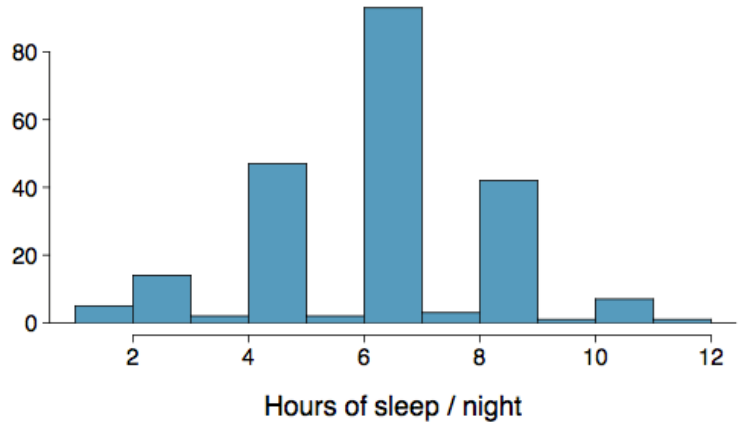
Notation [English]	i [which game]	X_i [value]	$X_i - \bar{X}$ [deviation from mean]	$(X_i - \bar{X})^2$ [absolute deviation]
	1	56	19.4	376.36
	2	31	-5.6	31.36
	3	56	19.4	376.36
	4	8	-28.6	817.96
	5	32	-4.6	21.16

Variance

Variance is roughly the average squared deviation from the mean.

$$s^2 = \frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}$$

- The sample mean is $\bar{x} = 6.71$, and the sample size is n = 217.
- The variance of amount of sleep students get per night can be calculated as:



$$s^2 = \frac{(5-6.71)^2 + (9-6.71)^2 + \cdots + (7-6.71)^2}{217-1} = 4.11\ hours^2$$

Variance (cont.)

Why do we use the squared deviation in the calculation of variance?

- To get rid of negatives so that observations equally distant from the mean are weighed equally.
- To weigh larger deviations more heavily.

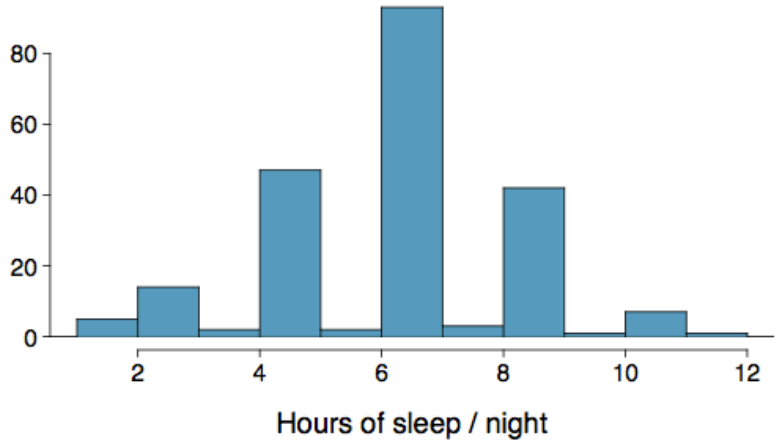
Standard Deviation

The *standard deviation* is the square root of the variance, and has the same units as the data.

$$s = \sqrt{s^2}$$

- The standard deviation of amount of sleep students get per night can be calculated as:

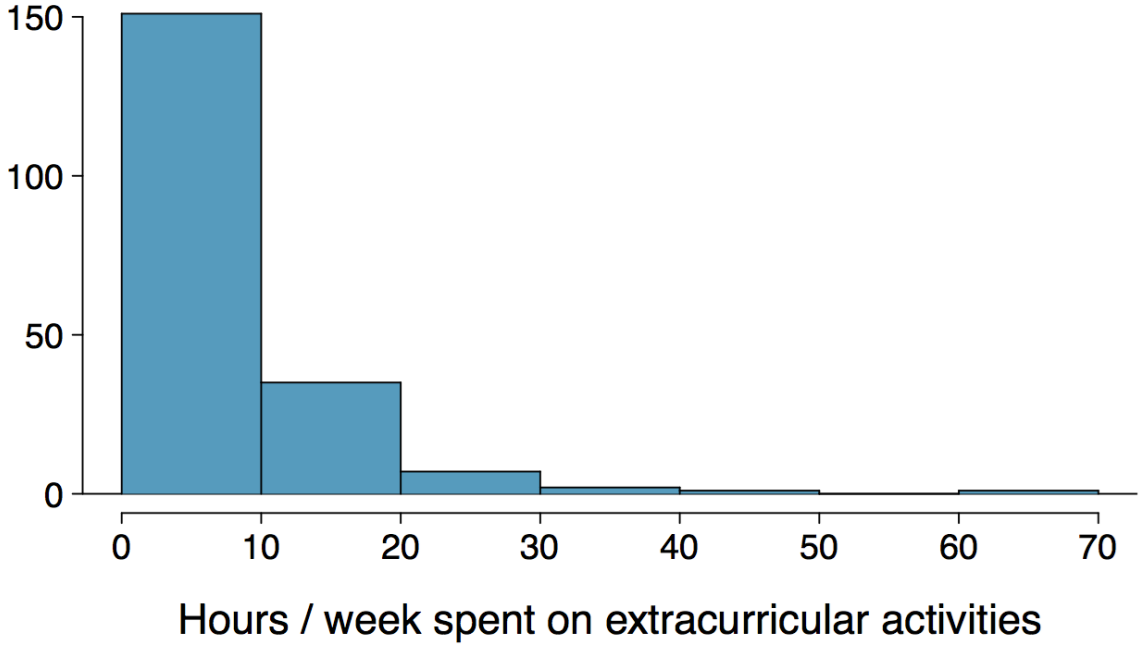
$$s = \sqrt{4.11} = 2.03 \; hours$$



- We can see that all of the data are within 3 standard deviations of the mean.

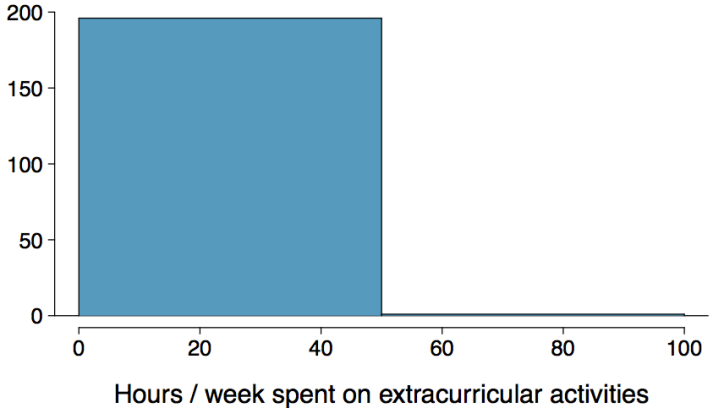
Histograms - Extracurricular Hours

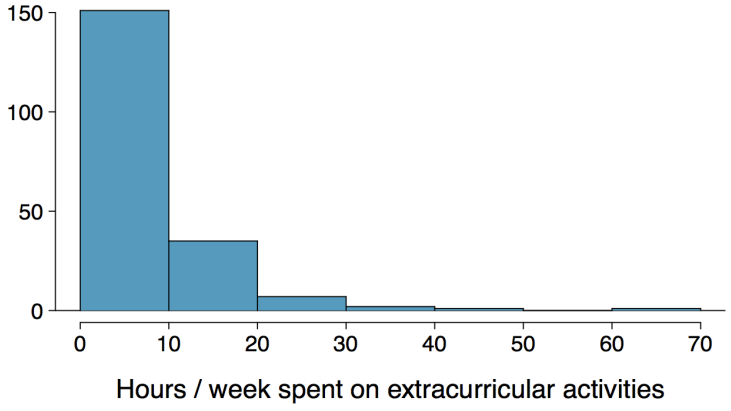
- Histograms provide a view of the *data density*. Higher bars represent where the data are relatively more common.
- Histograms are especially convenient for describing the *shape* of the data distribution.
- The chosen *bin width* can alter the story the histogram is telling.

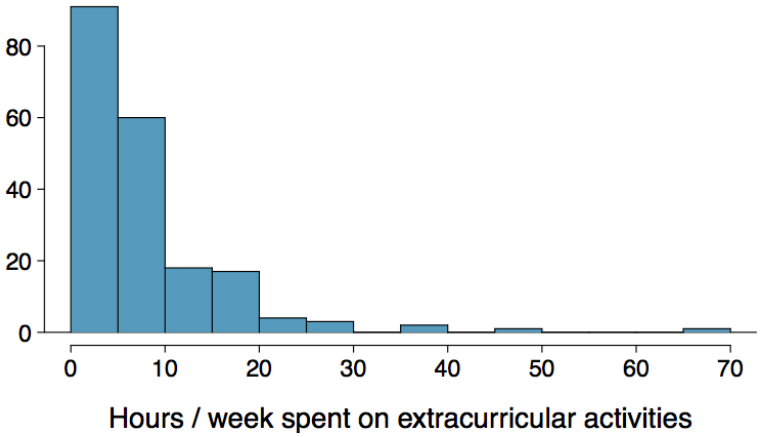


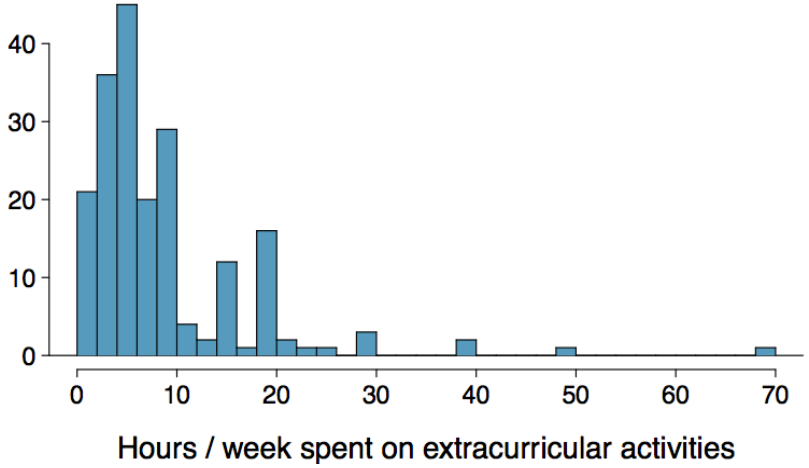
Bin Width

Which one(s) of these histograms are useful? Which reveal too much about the data? Which hide too much?





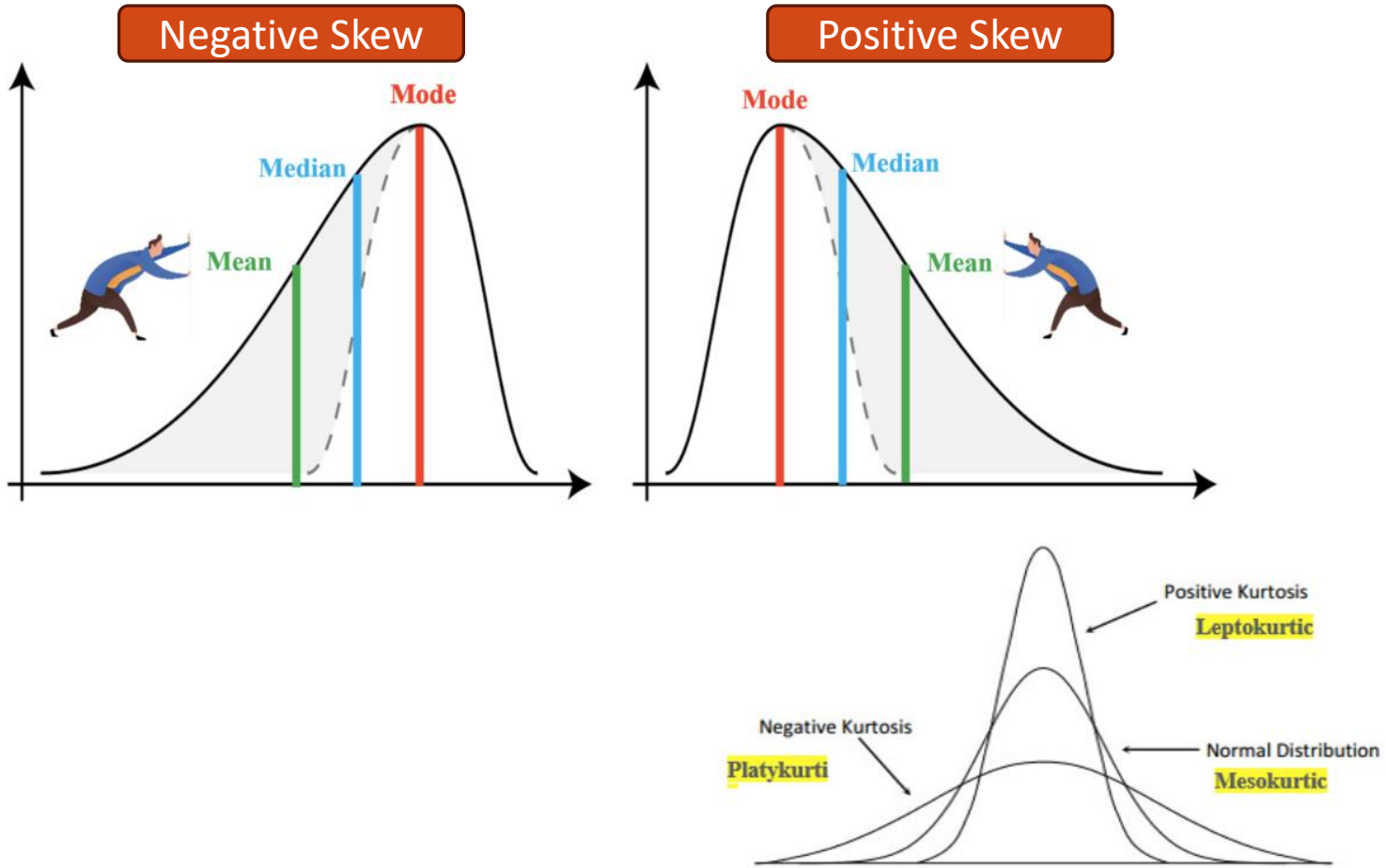




Descriptive Statistics

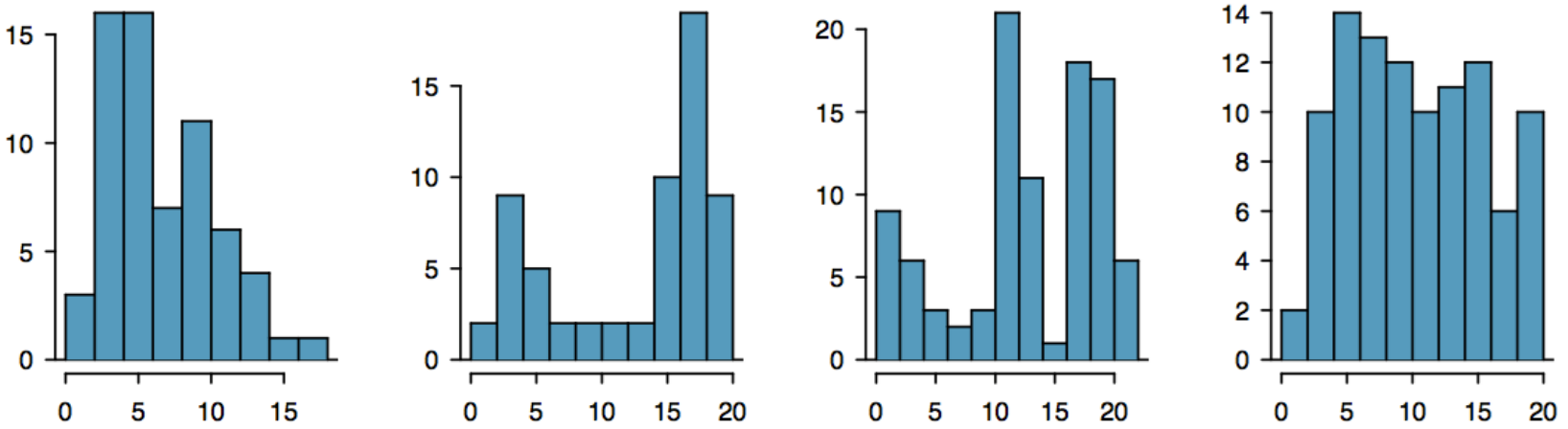
Shape

- Skewness, Kurtosis



Shape of a Distribution: Modality

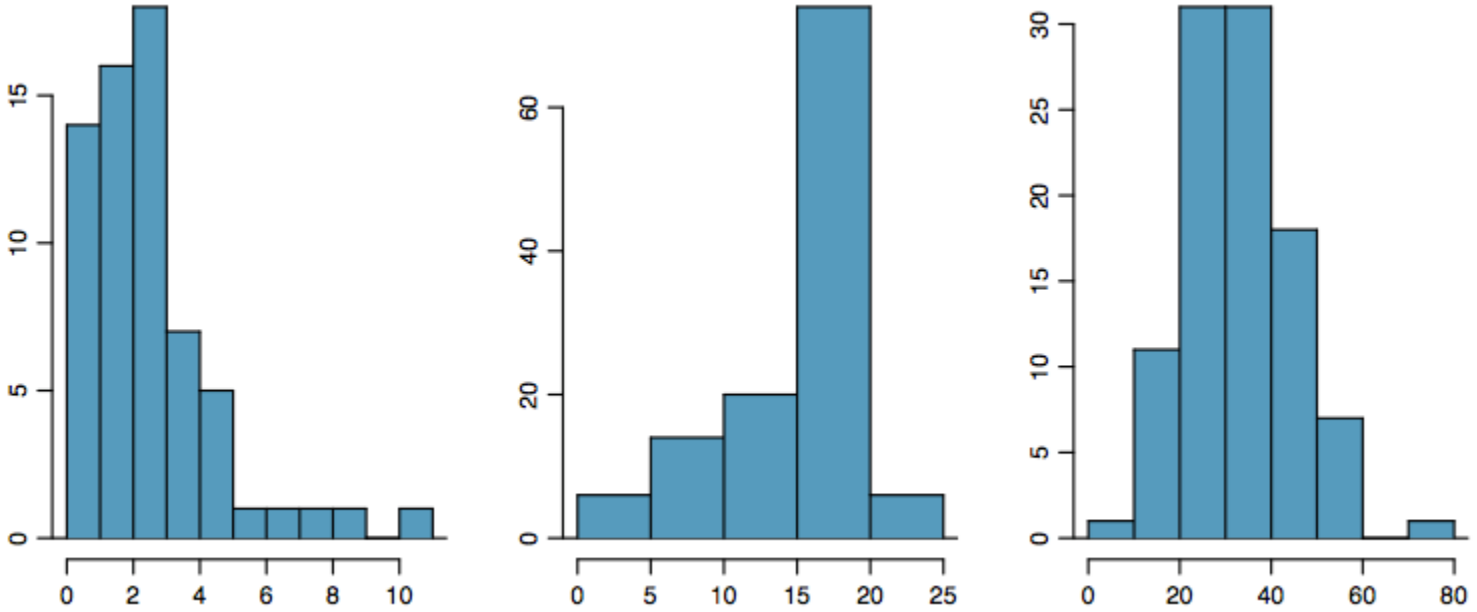
Does the histogram have a single prominent peak (*unimodal*), several prominent peaks (*bimodal/multimodal*), or no apparent peaks (*uniform*)?



Note: In order to determine modality, step back and imagine a smooth curve over the histogram -- imagine that the bars are wooden blocks and you drop a limp spaghetti over them, the shape the spaghetti would take could be viewed as a smooth curve.

Shape of a Distribution: Skewness

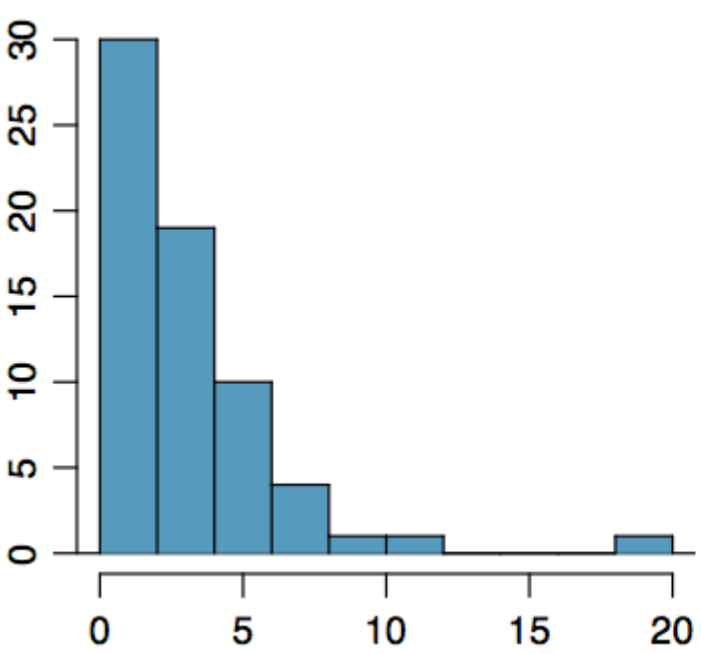
Is the histogram *right skewed*, *left skewed*, or *symmetric*?

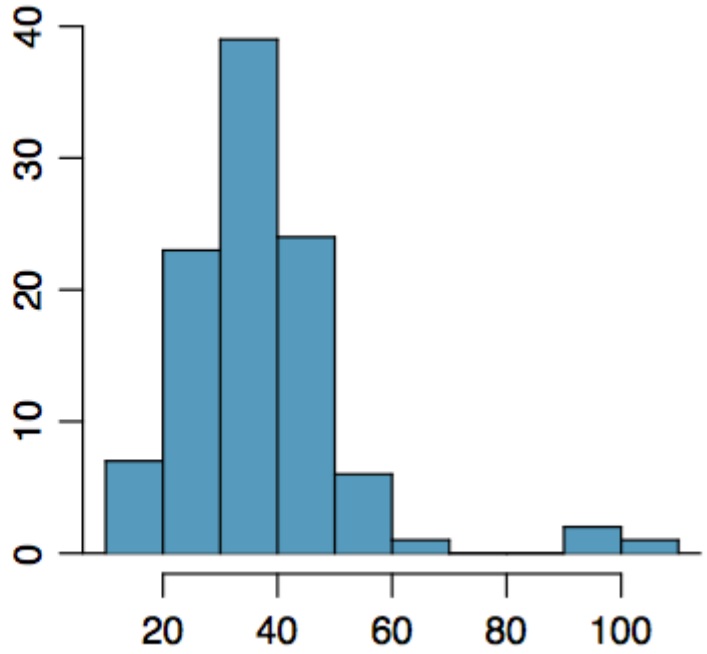


Note: Histograms are said to be skewed to the side of the long tail.

Shape of a Distribution: Unusual Observations

Are there any unusual observations or potential *outliers*?

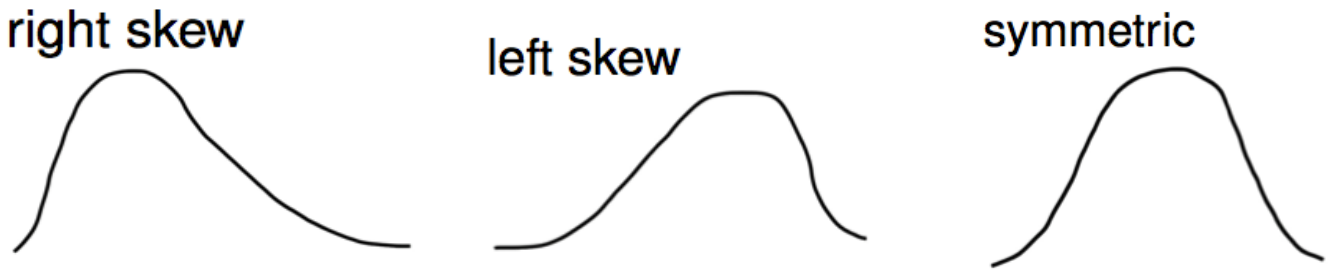




Commonly observed shapes of distributions

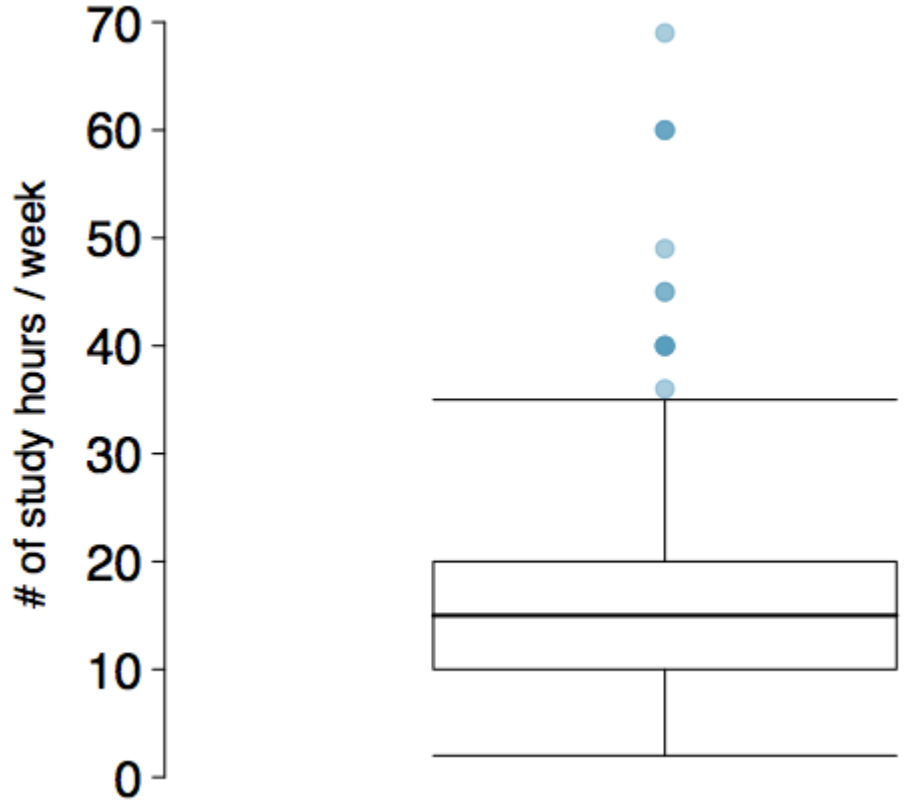
Modality

Skewness

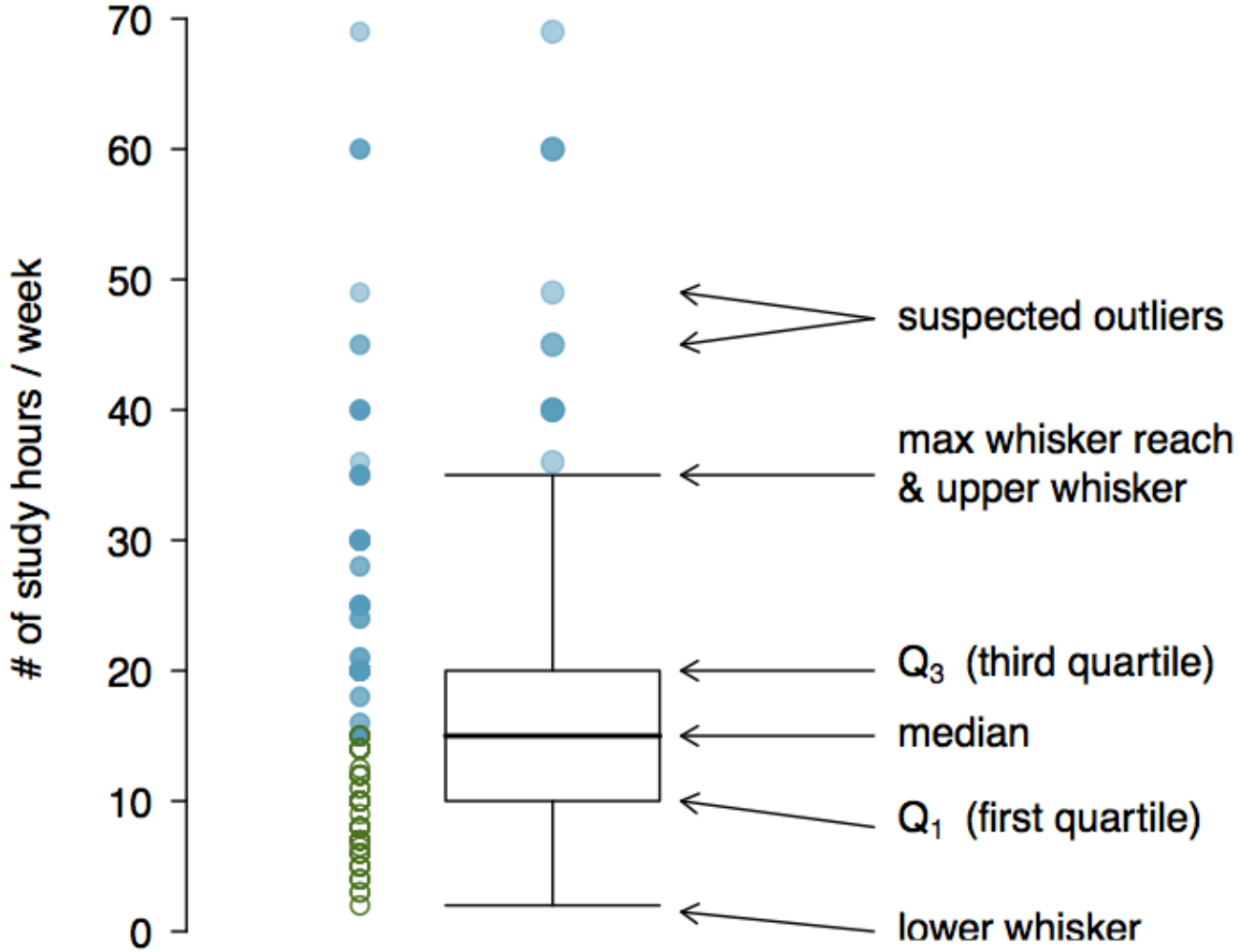


Box Plot

The box in a *box plot* represents the middle 50% of the data, and the thick line in the box is the median.



Anatomy of a Box Plot



In Class Activity

GOOGLE SHEET

DESCRIPTION ON MY COURSES