Name_____

AP Statistics CED 3.1 Daily Video 1 (Skill 1.A)

Introducing Statistics – Do the Data We Collected Tell the Truth?

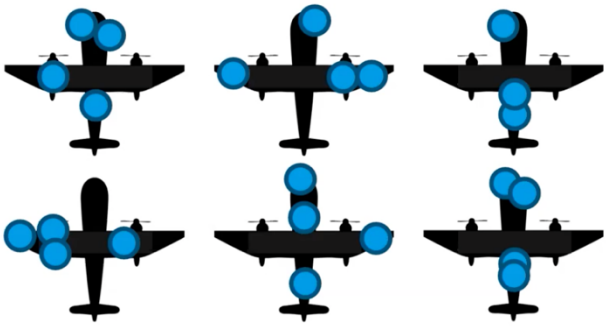
What Will We Learn?

What problems arise when we collect samples?
How does the way in which we collect data inform our analysis of the data?
What should we be wary of as we collect data?

Abraham Walk and the Statistical Research Group (Listen as speaker introduces context)

Wald's Airplane Problem

Take a pause: Where should they put extra armor?
a) Nose
b) Main Wings
c) Body
D) Engines
E) Tail Wings



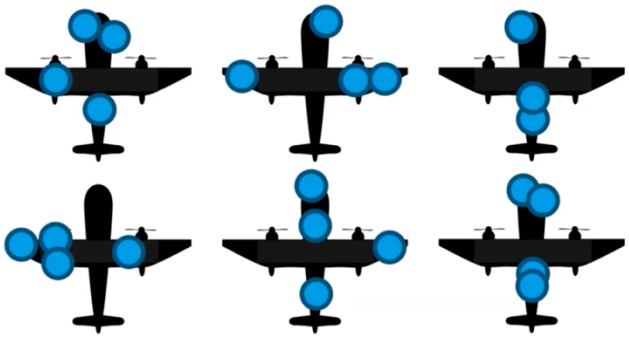
Soldiers made bullet hole charts for planes that came back from bombing runs over the Nazi-occupied zone.

Silhouette from: grmarc / Shutterstock.com

Example inspired by Joe Blitzstein "Harvard Thinks Big" lecture: https://youtu.be/dzFf3r1yph8.

Wald's Insight

Where should they put extra armor?
a) Nose
b) Main Wings
c) Body
D) Engines
E) Tail Wings

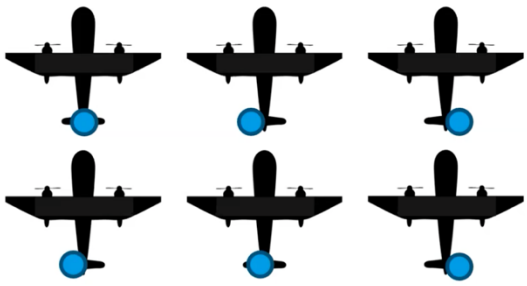


Soldiers made bullet hole charts for **planes that came back** from bombing runs over the Nazi-occupied zone.

Silhouette from: grmarc / Shutterstock.com

Example inspired by Joe Blitzstein "Harvard Thinks Big" lecture: https://youtu.be/dzFf3r1yph8.

Planes NOT in Our Sample



The planes not included in our sampling method are the planes that went down—they have a vulnerable spot.

Silhouette from: grmarc / Shutterstock.com

What Should We Take Away?

A proper analysis of data must take into account _____ the data were _____.
Sometimes, our samples _____ be representative of the whole _____.
Always take stock of _____ the individuals in your sample may _____ from those not sampled.

Name_____

AP Statistics CED 3.2 Daily Video 1 (Skill 4.A)

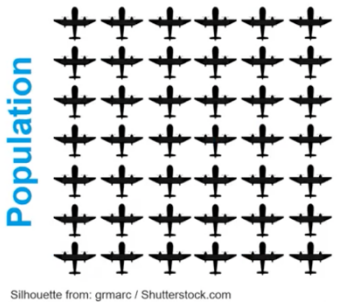
Introduction to Planning a Study

What Will We Learn?

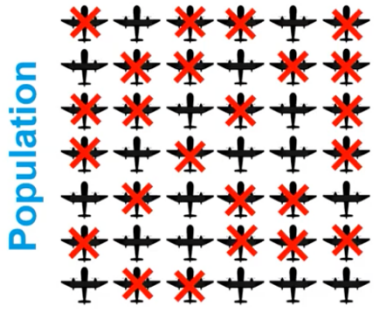
What is the difference between a population and sample?
What is the difference between and observational study and an experiment?
What types of conclusions can we draw from different types of studies?

Wald's Airplane Problem (What the video for a review of this context.)

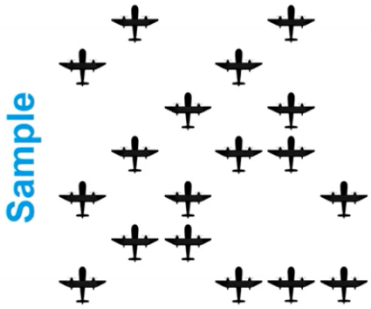
Population Versus Sample



Silhouette from: grmarc / Shutterstock.com



Silhouette from: grmarc / Shutterstock.com



Population: _____ planes that went on bombing missions and that were hit.
Sample: a _____ of a population. Often, we can't measure the _____. We must measure a _____ and _____ about a population.

Were the sampled hit locations representative of the entire population? From the video: NO
Why not? _____ only the planes that made it back safely are included in the sample. These planes tended to differ from others in the population.

Generalizations

It is only appropriate to make _____ about a population based on samples that:
*Are _____ selected or otherwise representative of that population.
*Were selected from _____ specifically. **Example**: If we observe that a representation of lima beans grow quickly in humid climates, we can't necessarily infer that black beans grow quickly in a humid climate, as well.

Racial Income Gap

Each year, to measure income gaps (among other things) in American population, the U.S. Census Bureau and U.S. Bureau of Labor Statistics conduct a sample survey called the Current Population Survey (CPS). Median Annual Income (2018 Census Bureau Survey Data):

White households: $70, 642
Black households: $58,665

Difference: $11, 977 that year

If you think about that over time:
10 years: $119,770
20 years: $239,540
45 years: $538,965

Could be the difference between affording
To own your home
To pay for kids' college
To get good healthcare

Cause of racial wage gap?
Social Factors: Inequity of schools; Familial connections
Current, Direct Discrimination: Hiring Discrimination

Confounding Factors – Hard to parse out if the cause is one of these, a combination of these or none of these

Name_____

Racial Income Gap

This survey is an _____.

Survey was taken _____ treatments of individuals.

We cannot infer _____.

Types of Observational Studies

Retrospective: examine _____ data for a set of individuals.

Prospective: follow a sample of individual _____ collecting data.

Previous example was _____.

What if:

What if I really wanted to know whether hiring discrimination was still a factor in labor markets? How can we control for the other possible explanations to ensure that confounding does not happen?

The Resume Experiment

Note: These names were used as the main example in the original study paper. Birth certificate records were used to find the names that were most uniquely given to what children and the names that were most uniquely given to black children in Massachusetts.

White Female	Black Female	White Male	Black Male
Allison	Aisha	Brad	Darnell
Anne	Ebony	Brendan	Hakim
Carrie	Keisha	Geoffrey	Jermaine
Emily	Kenya	Greg	Kareem
Jill	Latonya	Brett	Jamal
Laurie	Lakisha	Jay	Leroy

Study: Bertrand, Marianne and Sendhil Mullainathan. "Are Emily And Greg More Employable Than Lakisha And Jamal? A Field Experiment On Labor Market Discrimination," *American Economic Review*, 2004, v94(4,Sep), 991-1013. https://www.nber.org/papers/w9873

The Resume Experiment

*Resumes were sent to employers in Boston and Chicago.

*Each employer was randomly assigned a resume with a commonly white name or commonly black name.

*The aggregate callback rates were measured for both resume groups.

Experiments

Experiments: Different conditions (treatments) _____ upon subjects.

*In the resume study, the treatment of _____ is imposed on employers.

*If the study is well-designed, it _____ determine causal relationships.

What Should We Take Away?

A sample is a _____ of a population.

We cannot infer _____ relationships from _____ studies.

We can _____ from samples that are _____ selected or otherwise _____ of the population.

Name_____

AP Statistics CED 3.3 Daily Video 1 (Skill 2.B)

Random Sampling and Data Collection

What Will We Learn?

Why do we collect random samples?

How do we collect a simple random sample (SRS)?

How do we implement more-complex random sampling techniques: stratified, cluster, systematic?

San Antonio Income Segregation

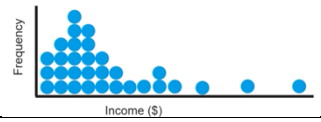
*Most American cities have severe economic segregation. This means that household in the same neighborhood have similar incomes, but incomes across neighborhoods tend to be quite different.

*San Antonio is one of the most economically segregated cities in the United States.

How can we measure the _____ in San Antonio?

Important Note

Due to the right-skewed nature of most income data, the median is usually the preferred measure of center.



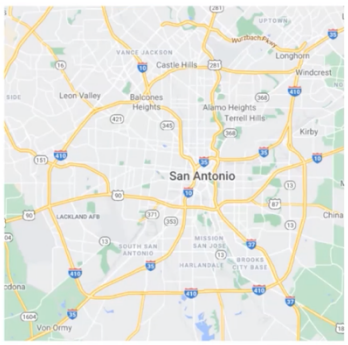
Option 1 – Census

Census: collects data for _____ in a population. If done well, this is the best way to measure _____ household incomes in San Antonio. Problem: _____

Option 2 – Random Sample

Much easier to do than measuring _____. If done well, should be _____ of the general population of _____ San Antonio households.

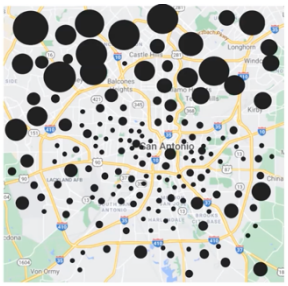
Map of San Antonio



There are approximately 500,000 households in San Antonio.

Take a pause: If you wanted to randomly sample 10,000 household (2% of the population size) to estimate the median household income, what exactly would you do?

Simple Random Sample (SRS): Sample in which every group of a given size has an _____ of being chosen. **Example:** Let's estimate the median household income by randomly selection 10,000 homes (n = 10,000) and finding the median among the sample.



SRS: _____ all households 1 – 500,000. Then use a random number generator to select 10,000 numbers between 1 and 500,000, _____. To the right is one possible SRS, where dot = selected home and dot size = income

Take a pause: What patterns do you notice? (Circle as indicated in the video.)

North side tends to have _____. Income is consistent within regions and varies _____ regions. This is known as _____.

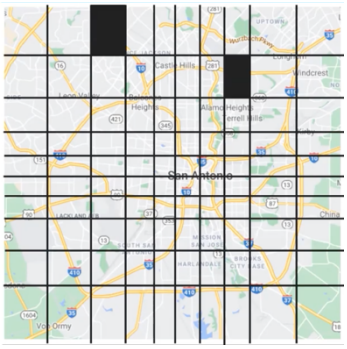
Take a pause: Do you believe our sample is representative of the population? _____ How difficult would it be to collect our sample data? _____

In this case, the median of sample: _____

There must be an easier way to get a random sample!

Name_____

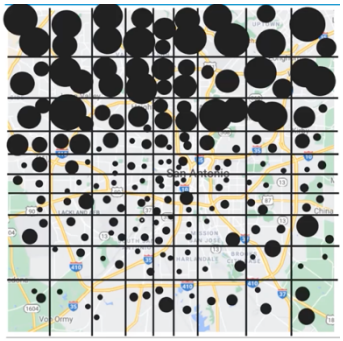
Cluster Random Sample



*Population is divided into _____ of individuals that are near one another.
*SRS of _____ is taken.
*_____ individuals within _____ (randomly selected) cluster are sampled.
Clustered by region: 100 regions, each with about 5,000 homes. Randomly select _____. Sample _____ homes in clusters. (*n*=10,000)

Take a pause: Do you believe our sample is representative of the population? Next Video
How difficult would it be to collect our data? _____
In this case, the median of the sample: _____

Stratified Random Sample



*Population is divided into _____, based on a _____.
*SRS _____ each stratum is taken
*Selected individuals are _____ into larger sample.
Divide strata by region (let's use the same 100 regions). Take a SRS of 100 homes _____ each strata. _____ all sampled homes (*n*=10,000) and find the median.
Take a pause: Do you believe our sample is representative of the population? Next Video How difficult would it be to collect our sample data? _____
In this case, the median of the sample: _____

Cluster Versus Stratified

Both involve grouping: What's the difference?

Cluster
Start by grouping (ideally, heterogenous)

SRS of groups, sample **all** individuals in selected groups

Stratified
Start by grouping (ideally, homogenous)

SRS **within** each group

Systematic Random Sample

*Randomly choose a _____, then sample at a fixed periodic interval.
*Example: You want to sample classmates' rating of cateteria food, All students are in line waiting to get food at lunch. You number the first 20 people in line 1-20. Then you _____ select a number from 1 to 20, sample the corresponding person's opinion, then sample every _____ person opinion in line after that.
*The primary advantage of this method is that it's _____ to collect the sample, especially in situations in which individuals in the population are "_____" in some way.

Lingering Question

Estimate for the true median household income:

SRS	Cluster Sample	Stratified Sample
$50,500	$110,350	$51,025

What Should We Take Away?

_____ when well-executed, tend to provide representative samples.
A Simple Random Sample (SRS) gives every group of 'n' individuals an _____ chance of selection. Cluster sampling creates groups, then randomly samples _____ groups. Stratified sampling creates groups, then randomly samples _____ each group.

Name_____

AP Statistics CED 3.3 Daily Video 2 (Skill 1.C)

Randomly Sampling and Data Collection

What Will We Learn?

What criteria can we use to evaluate sampling methods?

What are advantages and disadvantages to using different sampling methods?

In which type of situation is cluster sampling more effective than stratified sampling, and vice-versa?

San Antonio Income Segregation (Watch as video reviews SRS, Cluster Sample & Stratified Sample)

From Last Video:

Estimates for true median household income:

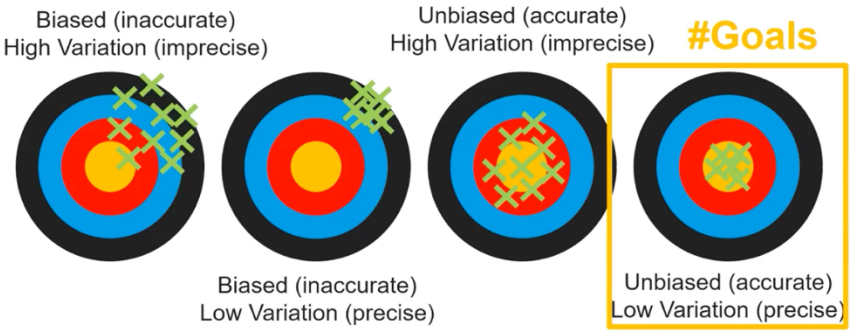
Which should we trust the most?

SRS	Cluster Sample	Stratified Sample
$50,500	$110,350	$51,025

Bias & Variability

Bias is a measure of _____.

Variation is about _____.



True Median Income

True median household income in San Antonio at time this data was collected ≈ $51,000

If sampled many times…

Each of these methods has some variation due to the random nature of selecting a sample.

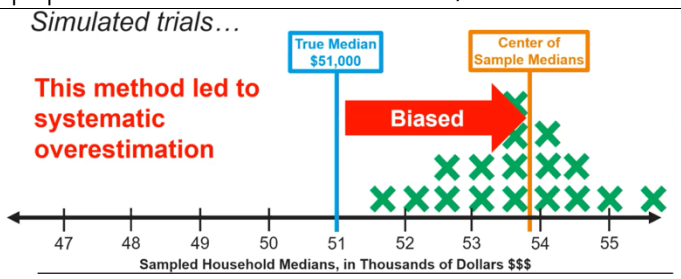
*Let's _____ repeating these sampling methods many times.

*Plot _____ of the sample median estimates using a _____.

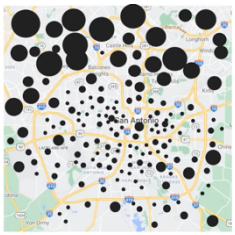
*See where estimates fall compared to true population median income of $51,000.

Non-Random Sample

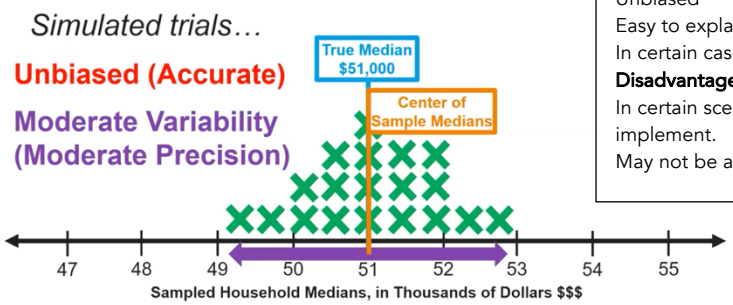
Non-random samples generally lead to systematic overestimation.



Simple Random Sample (SRS)



Simple Random Sample of 10,000 households.



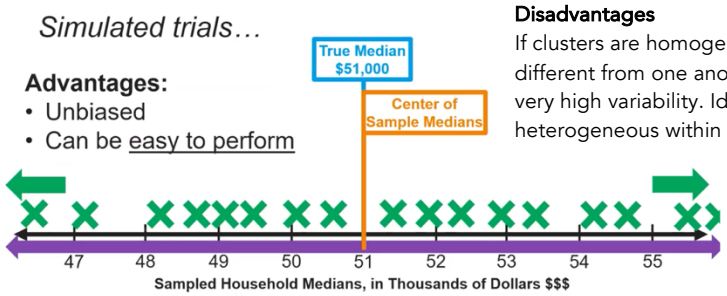
Advantages:
Unbiased
Easy to explain
In certain cases, can be easy to perform

Disadvantages
In certain scenarios, can be difficult to implement.
May not be as precise as other methods

Name_____

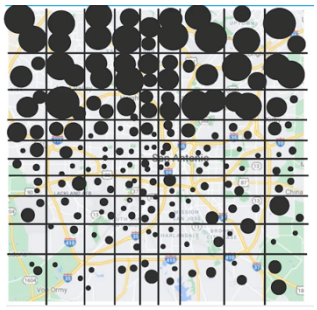
Cluster Random Sample

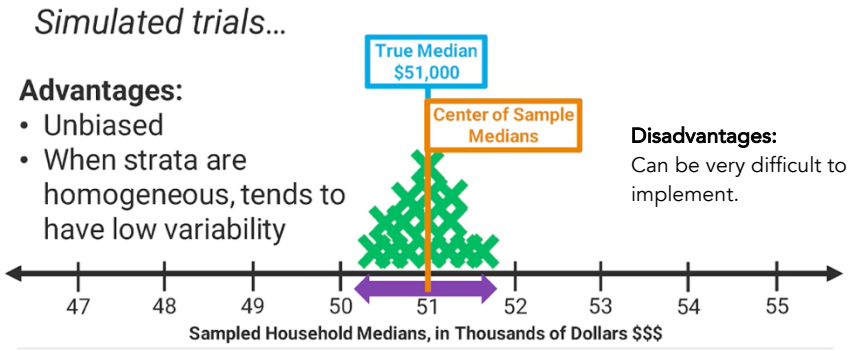
Because there is severe income segregation, Income is consistent _____ regions
Income _____ between regions



Disadvantages
If clusters are homogeneous but very different from one another, can have very high variability. Ideally, you want heterogeneous within groups.

Stratified Random Sample





Disadvantages:
Can be very difficult to implement.

Because of income segregation…

Income is _____ with regions. Each possible sample has a _____ mix of incomes from each region → precise estimates

What Should We Take Away?

Random sampling tends to provide _____ estimates.
_____ random sampling is effective when clusters are _____ and similar to one another.
Stratified random sampling is most effective when strata are _____.

Name_____

AP Statistics CED 3.4 Daily Video 1 (Skill 1.C)

Potential Problems with Sampling

What Will We Learn?

What types of sampling methods lead to biased estimates?
How can we describe the ways in which a sampling method lead to over/underestimates?
What are some potential problems that arise from asking survey questions?

College "Success" Data

If you're a high school student in the United States, you've probably gotten promotional pamphlets from colleges. One of my students recently received one that claimed…
"Based on a random sample of recent graduates, about 99.7% of our former students are working full time in the career of their choice!"

Student asked: "But, Mr. Young-Saver, what percent of their students actually graduated?
They only sampled _____ students who **actually graduated**! By law, most college graduate/transfer rate data is publicly accessible through the Integrated Postsecondary Education Data System (IPEDS). An investigation revealed that, "Only 40% of their incoming freshmen graduated within 6 years (it's a 4-year school). This means that _____ of that _____ had good job outcomes. The other _____ who knows…

Bias and Non-Random Samples

Bias: a systematic tendency to _____ over others.
Undercoverage bias: When part of the population has a _____ of being included in a sample. Example: excluding the students who didn't graduate.
Nonresponse Bias: In a recent report, a university found that _____ of its student had secured a paid summer internship in the career field of their choice. How did the university collect this data? They _____ selected a sample of students and sent them a survey. Only _____ of those students responded. Nonresponse: When individuals chosen for a sample _____ respond. Lead to bias if these individuals _____ from respondents.

Model Response

Q: What is a potential source of bias in the university's sampling method?
When writing about bias in sampling methods:
1. Identify the _____ and the _____.
2. Explain how the sampled individuals might _____ the general population.
3. Explain how this leads to an _____.

Model Response – Example

Q: What is a potential source of bias in the university's sampling method?
1. Population: _____ | Sample: _____
2. Students without paid internships may be ashamed and _____ choose not to respond to the survey; thus, they are _____ in the sample.
3. Because students without paid internships may _____ to the survey less often, _____ may be an _____ of the percentage of students with a paid internship this summer.
Putting it all together: Students who didn't find paid internships may be ashamed, making them _____ to respond to the survey. Therefore, this sampling method may include a higher proportion of interning student than in the full population. So, 85% is likely an _____ of the true percentage of _____ students who have paid internships this summer.

Name_____

Voluntary Response Bias

Voluntary response bias: Occurs when an invitation is sent to _____ individuals in a population to participate. Those who choose to participate (_____) may _____ from individuals who don't choose to participate.

Example: You're estimating the percentage of people who enjoy running.

-You post an advertisement saying you _____ for a running study. You send a _____ to the people who respond to the ad asking them whether or not they enjoy running.

-Advertising your study as a "_____" may be more likely to attract volunteers who _____, rather than those who don't like it.

- Since the people who volunteer may be _____ to have favorable attitudes towards running than the general population, you may _____ the true population of people who like running.

Types of Bias (So far)

Undercoverage bias

Nonresponse bias

Voluntary response bias

Important: On a free-response question, if you're unsure _____ try to use one of these vocabulary terms. Instead, just describe the bias, how it arises, and whether it lead to an underestimate or overestimate.

Bias Specific to Surveys

Question wording bias: When survey questions are confusing or _____.

Example "Which show do you prefer: *Diners, Drive-ins, and Dives,* hosted by the incredibly talented, funning, and interminable mayor of Flavortown, chef Guy Fieri, of *Iron Chef,* hosted by Alton Brown?

Self-reported response bias: When individuals _____ report their own traits.

Example: I report being able to bench-press 350 lbs.

What Should We Take Away?

_____ arises when certain responses are _____ favored over others. When describing bias, _____ how the sample may systematically _____ from the population and the resulting _____ of bias.

Name_____

AP Statistics CED 3.5 Daily Video 1 (Skill 1.C)

Introduction to Experimental Design

What Will We Learn?

How does confounding affect the relationship between two variables?

What are the components of an experiment?

Take Note!

Do students who regularly take notes during AP Statistics class earn higher grades than students who just sit and listen? We can design a study to determine if this is true or not.

We could do an observational study after the midterm exam.

-Which students regularly _____ and which _____?

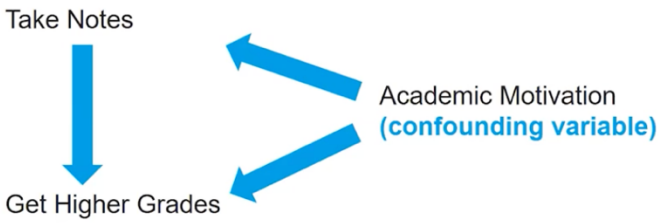
-How do the grades _____ between the _____ groups?

Suppose the group who took notes earned a much higher grade average on the exam. Can we conclude that taking notes _____ higher scores? Why or Why not?

Does Taking Notes = Higher Grades?

If not what else could be the cause?

Confounding variable: Another variable that is _____ to the _____ variable and _____ the _____ variable and may create a _____ perception of association between the two.



Do students who regularly take notes during AP Statistics class earn higher grades than students who just sit and listen.

Observational study: possible

_____

(academic motivation)

What about an Experiment?

Experiment – Treatment _____ imposed on experimental units.

Explanatory variables (factor) – May help _____ a change in the response variable.

Response Variable – Used to _____ the outcome of a study.

What about an Experiment? – Example

Experiment – Let students _____ whether to take notes or just listen.

Explanatory variable – Does the student take notes? (two levels - _____)

Response variable – _____ after one unit.

This is still a _____ experiment, because we allowed the student to decide if they wanted to take notes. So academic motivation may still be a _____.

What makes a well-designed experiment? Check out the next video!!!

What Should We Take Away?

Observational studies cannot determine _____ due to possible _____.

An experiment intentionally imposes _____ on the participants in order to observe a _____.

Name_____

AP Statistics CED 3.5 Daily Video 2 (Skill 1.B)

Introduction to Experimental Design

What Will We Learn?

What are the principles of a well-designed experiment?

A Well-Designed Experiment

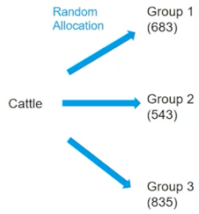
-Comparisons of at least _____ treatment groups, one of which could be a _____ group.
-_____ assignment/allotment of treatments to experimental units.
-_____ (use enough experimental units in each treatment group)
- _____ of potential _____ variables where appropriate

Bulls-Eye!

Does painting eyes on the rear of cattle help reduce the chance of attack from predators? A Study in Botswana found that eyespots painted on cattle were associated with reduced attacks by carnivores. Cattle were randomly assigned to receive eyespots, cross-marks, or to remain unmarked. Of the 683 cattle with eyespots, none were attacked. Four of the cross-marked cattle were killed and 19 of the unmarked cattle were killed by lions or leopards.

Comparison of groups: _____, _____, _____
Random assignment: cattle were _____ assigned treatments
Replication: group sizes _____, _____, and _____
Control: experiment was conducted in the _____ general location during the _____ time period.

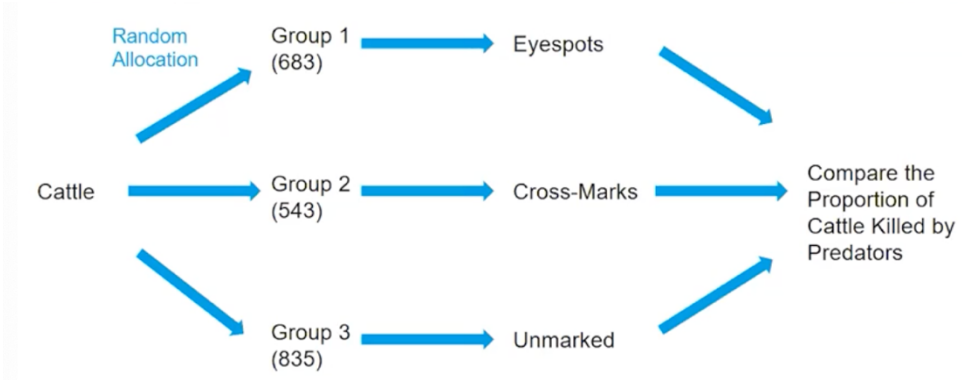
Bulls-Eye!



Random Allocation (one method):

* _____ cattle from 1 to N.
* The _____ random number selected corresponds to a cow that will be assigned to the first group.
* Continue until the desired number of cattle have been assigned to each _____ group.

Bulls-Eye!



What Should We Take Away?

A well-designed experiment should include: _____ between at least two groups, _____ of treatments to experimental units, _____ of treatments to multiple experimental units, and _____ of possible confounding factors.

Name_____

AP Statistics CED 3.5 Daily Video 3 (Skill 1.C)

Introduction to Experimental Design

What Will We Learn?

What are an advantage and disadvantage of a completely randomized design?
What is blocking, and how does it help reduce variability?
What is the placebo effect?

Immunotherapy for Melanoma

"Melanoma is a form of skin cancer characterized by the uncontrolled growth of pigment-producing cells (melanocytes) located in the skin. – Bristol-Myers Squibb, 2019

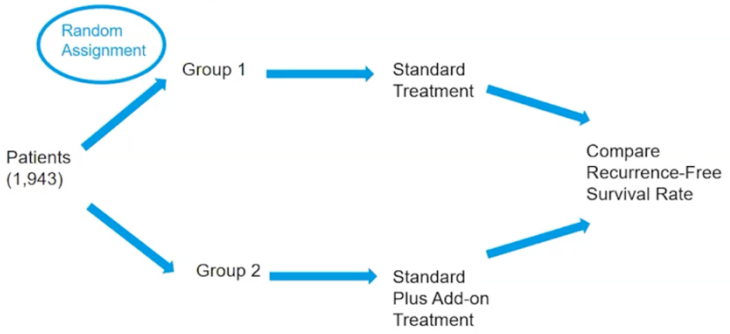
A recent study compared the effectiveness of an approved standard of care with a combination treatment of the standard care (low dose) plus an additional treatment. The recurrence-free survival rate was measured in both groups.

Immunotherapy for Melanoma

The experiment is a" _____, _____, _____"

Randomized

Random assignment tends to balance the effects of potential uncontrolled (confounding) variables so that differenced in responses can be attributed to the treatments



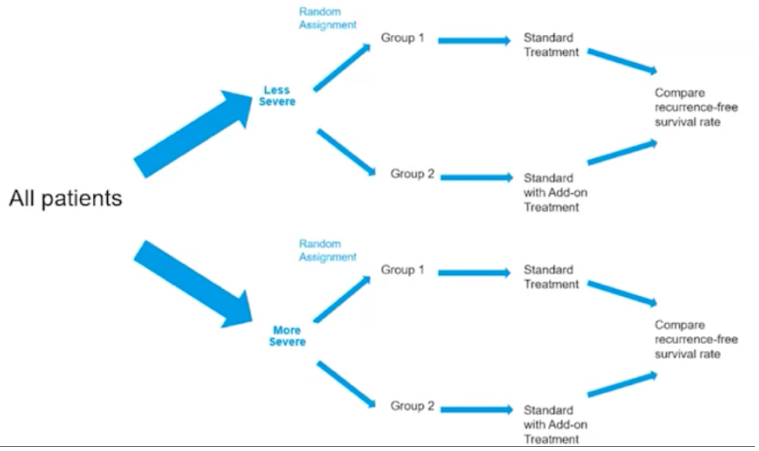
Can all differences in survival rate be attributed to the treatment? Is there something about patient that can affect the results??

Randomized Block Design

-Ensures that units within each block are similar with regard to a _____ variable.
-Helps separate natural variability from _____ due to the blocking variable.

Cancer stage can be used as a possible blocking variable, as the new treatment (drug) may work better for more-severe or less-severe cases.

Randomized Block Design (Complete the block design as you watch the video.)



Blocking is not _____ done the patients are assigned to the groups based on the variable.

After the blocking is done, _____ is performed within each block.

STATS MEDIC

Name_____

Placebo and Placebo Effect

Placebo: "_____" treatment that is _____ to the treatments being tested.

Example: Immunotherapy study:

-standard treatment – intravenous treatment every 4 weeks

-standard/Add-on – standard medicine (low does) every 2 weeks, and new medicine every 6 weeks

Time	Week 1	Week 3	Week 5	Week 7	Week 9	Week 11
Group 1	Standard	**Placebo**	Standard	**Placebo**	Standard	**Placebo**
Group 2	Low Dose	Low Dose	Low Dose +New	Low Dose	Low Dose	Low Dose +New

-Placebo effect occurs when experimental units have a _____ to a placebo.

Blinding

-Single-blind experiment: _____ do not know which treatment they are receiving, but _____ do (or vice versa)

-Double-blind: _____ the _____ nor the _____ who interact with subjects are aware of the treatments being administered.

Matched Pairs Design

-Special type of _____ design (blocks: size 2)

-Arranged such that blocks are _____ aligned.

-Within each block, both treatments are _____ assigned.

-(*Alternate: each subject may receive both treatments)*

What Should We Take Away?

A _____ balances potential confounding variables between groups. _____ design ensures similarity within blocks _____ randomization of treatments is performed.

The use of a _____ can help determine if an effect is _____ due to the treatment, and not simply because of the _____.

_____ occurs when the subject and/or the researchers are _____ of the treatment being administered.

Name_____

AP Statistics CED 3.6 Daily Video 1 (Skill 1.C)

Selecting an Experimental Design

What Will We Learn?

How can blocking improve the design of an experiment?

Under what conditions can an experiment be blinded?

High Cholesterol

High cholesterol level in people can be reduced by exercise or by drug treatment. A pharmaceutical company has developed a new cholesterol-reducing drug. Researchers would like to compare its effects to the effects of the cholesterol-reducing drug that is currently on the market. Volunteers who have a history of high cholesterol and who are currently not on medication will be recruited to participate in the study.

a) Explain how you would carry out a completely randomized experiment for the study.

The components and elements of a well-designed experiment include:

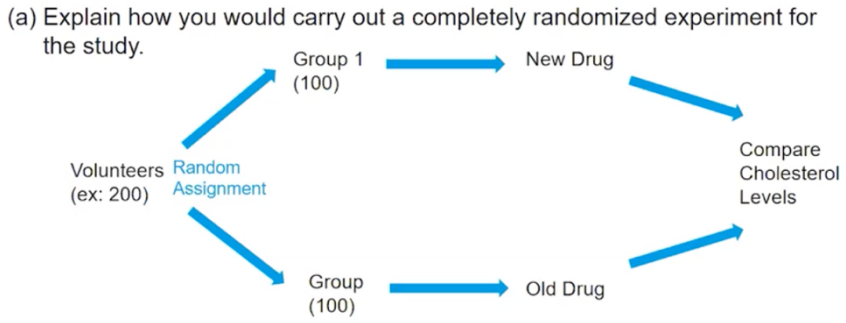
_____, _____, _____, _____

High Cholesterol – Example of written response:

a) Explain how you would carry out a completely randomized experiment for the study.

_____ for this study would be _____ assigned to one of _____ groups of approximately the same size. For example, if the sample size is 200 volunteers, then we can number the volunteers from 1 – 200. Then using a _____, we can select 100 numbers (without repeat). The 100 random numbers selected represent the 100 volunteers who _____. The remaining 100 volunteers would _____. We will then _____ the mean cholesterol level for both groups.

High Cholesterol – Example of diagram response:



High Cholesterol – Example of written response

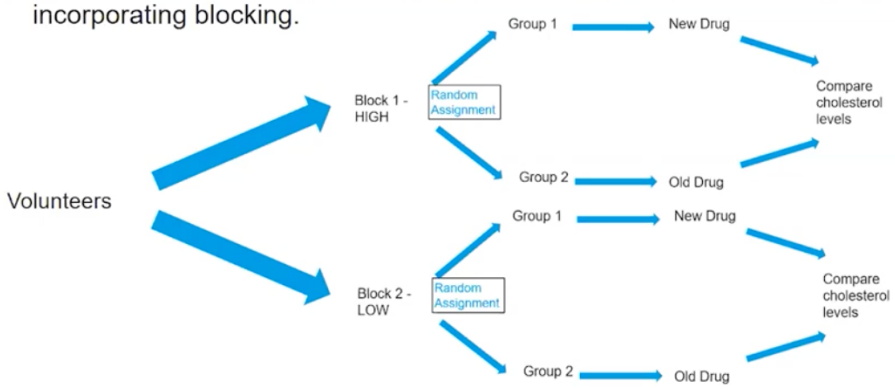
b) Describe an experimental design that would improve the design in (a) by incorporating blocking. What is another variable that could affect cholesterol?

Separate volunteers into _____ based on reported _____ levels (high or low). Within each block, _____ assign the volunteers to receive the _____ and _____ drug treatments as in part (a). Then compare the _____ cholesterol levels within the blocks and overall, for subjects taking the new drug versus the old drug.

Name_____

High Cholesterol – Example of diagram response

b) Describe an experimental design that would improve the design in (a) by incorporating blocking.



High Cholesterol – Example of written response

c) Can the experimental design in (b) be carried out in a double-blind manner? Explain
This question is asking: What is blinding? Is it present? (Make sure you answer with yes or no!)

Yes. _____ is possible as long as _____ and _____, including those _____ the medication and _____ cholesterol levels on the researchers' side, are not aware of which treatments are being given to each subject. This works if the _____ are made to be similar (in look, taste, administration method, etc.)

What Should We Take Away?

A _____ help to separate natural variability from differences due to the _____ variable.

_____ is possible when the _____ and/or _____ are unaware of the treatment being administered.

Name_____

AP Statistics CED 3.6 Daily Video 2 (Skill 1.C)

Selecting an Experimental Design

What Will We Learn?

How can we determine if a proposed study design is appropriate?

How can matched pairs design improve an experiment?

Tractor Plots

When a tractor pulls a plow through an agricultural field, the energy needed to pull that plow is called draft. The draft is affected by environmental conditions such as soil type, terrain, and moisture.

A study was conducted to determine whether a newly developed hitch would be able to reduce draft compared to the standard hitch. (A hitch is used to connect the plow to the tractor.) Two large plots of land were used in this study. It was randomly determined which plot was to be plowed using the standard hitch. As the tractor plowed that plot, a measurement device on the tractor automatically recorded the draft at 25 randomly selected points in the plot. After the plot was plowed, the hitch was changed from the standard one to the new one, a process that takes a substantial amount of time. Then the second plot was plowed using the new hitch. Twenty-five measurements of draft were also recorded at randomly selected points in this plot.

Tractor Plots (Record answers as you watch the video.)

a) What is the response variable in this study?

Identify the treatments.

What are the experimental units?

Tractor Plots (Use the prompt above to highlight as your watch the video.)

b) Given that the goal of the study is to determine whether a newly developed hitch reduces draft compared to the standard hitch, was randomization used properly in this study? Justify your answer.

Tractor Plots

c) Given the goal of the study was to determine whether a newly developed hitch reduces draft compared to the standard hitch, was replication used properly in this study? Justify your answer.

Tractor Plots

d) Plot of land is a confounding variable in this experiment. Explain why?

Name_____

Tractor Plots

e) Propose a method to improve the design of this study.

What Should We Take Away?

Proper _____ in an experiment requires that _____ experimental units receive the same treatment.

_____ designs are a special form of _____ block design using blocks of _____ experimental units, one receiving the treatment. Another type of _____ design includes giving each experimental unit _____ treatments in a _____ order.

Name_____

AP Statistics CED 3.7 Daily Video 1 (Skill 4.B)

Inference and Experiments

What Will We Learn?

What is statistical inference?

How does random assignment of treatments help determine statistical significance?

Under what conditions can results from an experiment be generalized to the entire population?

The Resume Experiment

Note: These names were used as the main example in the original study paper. Birth certificate records were used to find the names that were most uniquely given to what children and the names that were most uniquely given to black children in Massachusetts.

White Female	Black Female	White Male	Black Male
Allison	Aisha	Brad	Darnell
Anne	Ebony	Brendan	Hakim
Carrie	Keisha	Geoffrey	Jermaine
Emily	Kenya	Greg	Kareem
Jill	Latonya	Brett	Jamal
Laurie	Lakisha	Jay	Leroy

Study: Bertrand, Marianne and Sendhil Mullainathan. "Are Emily And Greg More Employable Than Lakisha And Jamal? A Field Experiment On Labor Market Discrimination," *American Economic Review*, 2004, v94(4,Sep), 991-1013. https://www.nber.org/papers/w9873

The Resume Experiment

-Resumes were sent to employers in _____ and _____.

-Each employer was _____ assigned a resume with commonly White name or commonly African-American name.

-The aggregate callback rates were _____ for both resume groups.

The Resume Experiment – Well Designed??

-Comparison? _____ (White versus African-American names)

-Random assignment? Each company given a _____ on resume

-Replication? _____ resumes for each group

-Control? Same resumes for each group, _____

The Resume Experiment – Results

-Overall, callback for resumes with White names: _____

-Overall, callback for resumes with African-American names: _____

-Difference between groups: _____

Statistical Significance

_____ allows us to conclude that very large observed changes are not merely _____ (statistically significant).

Statistically significant _____ between or among _____ treatment groups are _____ that the treatments _____ the effect.

Name_____

The Resume Experiment – More Questions

Does this difference occur due to the chance involved in the random assignment or due to the differences in the types of names? Either:
-Type of name _____ have an effect on callback rate, and the difference of _____ happened because of _____ in the random assignment, OR
-Type of name _____ callback rate

Statistical Significance

The probability (chance) of observing an outcome this extreme due to chance variation was _____ This indicates that there is zero percent chance that the difference happened by _____ alone. Which means that, in this case, _____ did affect callback rate. There for we have _____ evidence to support that the _____ on the resume affects the likelihood of a callback.

Statistical Inference

-Decisions from the _____ can be attributed to the distribution (_____) from which the sample was _____.
-If experimental units are _____ of the population, then the results can be _____ to the population of subjects _____ the ones in the study.
-Random selection of individuals gives a _____ that the sample will be _____ of the population.

What Should We Take Away?

_____ allows us to make decisions about the populations or treatments of interest based on the results from the _____.

Observed changes between treatment groups that are _____ than can be attributed by _____ are considered _____.

_____ of experimental units allows for results to be generalized to the population of interest.