Inference About Populations (later in the course)

Population

Inferences about Sampling

Infercences for Experiments

today's Goals

Explain the concept of sampling variability when making an inference about a population and how sample size affects sampling variability.

Explain the meaning of statistically significant in the context of an experiment and use simulation to determine if the results of an experiment are statistically significant.

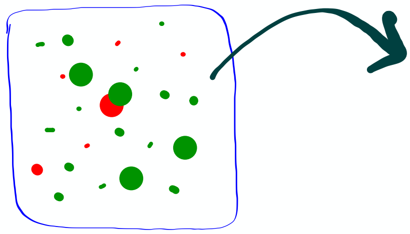
Inference for Sampling

When the members of a sample are selected at random from a population, we can use the sample results to make inferences about the population.

Exploring Sampling Variability

- Experiment on Page 270

Record in your notes

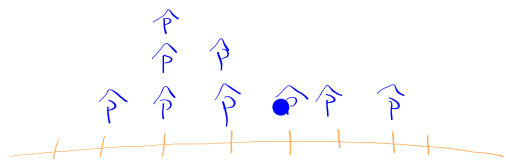


$\cancel{\hat{y} = a + bx}$

$\hat{p}$ your sample proportion

not all samples are alike

Even when making an inference from a random sample, it would be surprising if the estimate from the sample was exactly equal to the truth about the population.

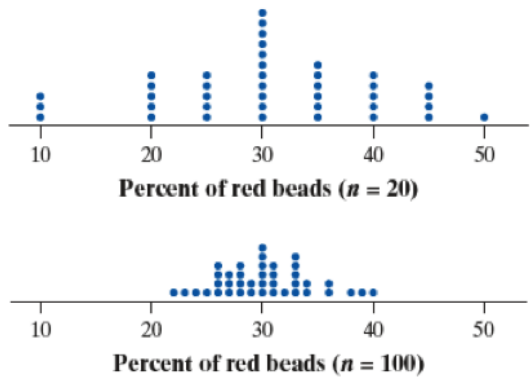


Inference for Sampling

Sampling variability refers to the fact that different random samples of the same size from the same population produce different estimates.

Sampling Variability and Sample Size

Larger random samples tend to produce estimates that are closer to the true population value than smaller random samples. In other words, estimates from larger samples are more precise.



Textbook
page 271
example

Inference for Sampling

How much do National Football League (NFL) players weigh, on average? In a random sample of 50 NFL players, the average weight is 244.4 pounds.

(a) Do you think that 244.4 pounds is the true average weight of all NFL players? Explain your answer.

amond Images/Getty Images

How much do National Football League (NFL) players weigh, on average? In a random sample of 50 NFL players, the average weight is 244.4 pounds.

(a) Do you think that 244.4 pounds is the true average weight of all NFL players? Explain your answer.

(a) No. Different samples of size 50 would produce different average weights. So it would be surprising if this estimate is equal to the true average weight of all NFL players.

nond Images/Getty Images

How much do National Football League (NFL) players weigh, on average? In a random sample of 50 NFL players, the average weight is 244.4 pounds.

(a) **Do you think that 244.4 pounds is the true average weight of all NFL players? Explain your answer.**

(b) **Which would be more likely to give an estimate close to the true average weight of all NFL players: a random sample of 50 players or a random sample of 100 players? Explain your answer.**

iamond Images/Getty Images

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(b) A random sample of 100 players, because estimates tend to be closer to the truth when the sample size is larger.

Read about
Margin of Error
on bottom of page 271

AP Stats Classwork – Section 4.3 Day 1B

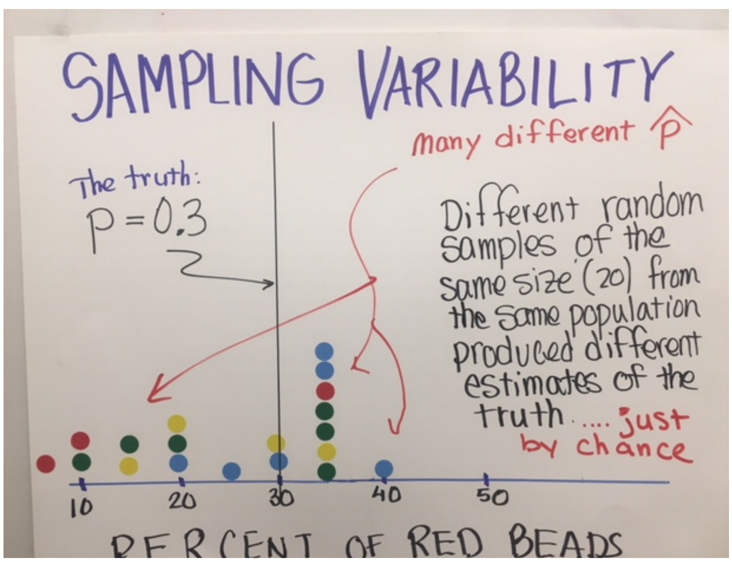
A. Inferences About Sampling
When samples are selected, we can make inferences about the population from which the sample was drawn.

AP Stats Classwork – Section 4.3 Day 1B

A. Inferences About Sampling
When samples are selected, we can make inferences about the population from which the sample was drawn.

we sampled a proportion

$\hat{p}$



B. Inferences for Experiments

The results of an experiment are considered Statistically significant if the difference in the response is too large to be accounted for by chance, or by the random assignment of experimental units to treatments.

When treatments are applied to groups formed by random assignment, we can conclude

cause and effect

When there is evidence that one treatment if more effective than another, there are two explanations for that evidence:

- It is possible that the two treatments are equally effective and that the difference was due to chance variability in random assignment.
- Or it is possible that one treatment is more effective than the other.

An Experiment: Does caffeine increase pulse rate?

A class decided to perform the caffeine experiment. In their experiment, 10 student volunteers were randomly assigned to drink cola with caffeine and the remaining 10 students were assigned to drink caffeine-free cola. Were their findings **statistically significant?**

The table shows the change in **pulse rate** for each student (Final pulse rate – Initial pulse rate), along with the mean change for each group.

	Change in pulse rate (Final pulse rate – Initial pulse rate)										Mean change
Caffeine	8	3	5	1	4	0	6	1	4	0	3.2
No Caffeine	3	–2	4	–1	5	5	1	2	–1	4	2.0

20 changes

Work on #1 and #2

	Change in pulse rate (Final pulse rate – Initial pulse rate)										Mean change
Caffeine	8	3	5	1	4	0	6	1	4	0	3.2
No Caffeine	3	–2	4	–1	5	5	1	2	–1	4	2.0

1. Find the difference in mean pulse rate for the groups. Does your initial reaction lead you to believe that they found evidence that caffeine does or does not increase heart rate? Explain.

3.2 − 2.0 = 1.2 difference

Possibly a difference of 1.2 beats isn't that big.

2. What are two possible explanations for the difference in mean pulse rate?

there is some evidence that caffeine increases pulse rate.

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1. Find the difference in mean pulse rate for the groups. Does your initial reaction lead you to believe that they found evidence that caffeine does or does not increase heart rate? Explain.

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2. What are two possible explanations for the difference in mean pulse rate?

(1) It was coincidence (chance) that the caffeine group had a larger change.

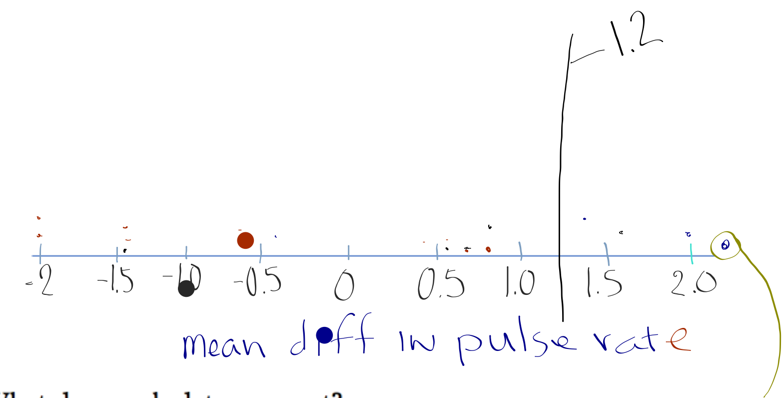
(2) Caffeine caused the change

Step 3: Fill in the table below with your simulated data.

Caffeine										
No Caffeine										

3. Find the mean change for each group in your simulation and subtract the means (Caffeine – No caffeine).

4. Add your difference in means to the dotplot on the board. Sketch the dotplot below.



$\frac{4}{18} = 22\%$

5. What does each dot represent?

The difference between means from one trial if caffeine has no effect.

6. What percentage of the dots are greater than or equal to the difference in means of 1.2 found in the experiment?

P-Value

Interpret this percentage: Assuming caffeine has no effect on the heart rate, there is a 22 % probability of getting a difference of 1.2 or more purely by chance.

7. Do you think the difference in means we found from our experiment is due to the caffeine or has it occurred purely by chance? Explain.

If percent ≤ 5%, yes that is pretty unlikely to happen on its own so it is probably due to caffeine.

If percent > 5%, NO, it's not that unlikely to be a coincidence

Interpret this percentage:
Assuming caffeine has no effect on the heart rate there is a ___% probability of getting a difference of 1.2 or more purely by chance.

7. Do you think the difference in means we found from our experiment is due to the caffeine or has it occurred purely by chance? Explain.

Statistically significant
If percent ≤ 5%, yes that is pretty unlikely to happen on its own so it is probably due to caffeine.

Not statistically signif.
If percent > 5%, NO, it's not that unlikely to be a coincidence

Big Ideas: Inference for Experiments

Sampling Variability	Statistically Significant
Different samples yield different estimates.	

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Different samples yield different estimates. Larger samples produce more accurate estimates.	

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Big Ideas: Inference for Experiments

Sampling Variability

- Different samples yield different estimates.
- Larger samples produce more accurate estimates.
- Margin of Error (MOE) creates an interval of plausible values

Sample Estimate ± margin of Error

Statistically Significant

When results from a study are too unusual to have occurred purely by chance.

Big Ideas: Inference for Experiments

Sampling Variability

- Different samples yield different estimates.
- Larger samples produce more accurate estimates.
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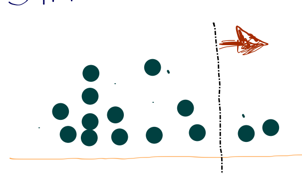
Simulation



prop. of dots ≤ 5% Statistic Signif.

prop. of dots > 5% Not Stat. Signif.

How many likes for Selena Gomez? ***Inference for sampling***

Selena Gomez was the most followed celebrity on Instagram in 2016 with 103 million followers. How many likes did she get for each Instagram post in 2016, on average? In a random sample of 30 posts, the average number of likes was 3.1 million.

a) Do you think that 3.1 million is the true average number of likes for all Instagram posts made by Selena Gomez in 2016? Explain your reasoning.

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a) Do you think that 3.1 million is the true average number of likes for all Instagram posts made by Selena Gomez in 2016? Explain your reasoning.

No. Different samples of size 30 would produce different average numbers of likes. So it would be surprising if this estimate is equal to the true average of likes for all posts.

b) Which would be more likely to give an estimate closer to the true average number of likes for all Instagram posts made by Selena Gomez in 2016, a random sample of 30 posts or a random sample of 100 posts? Explain your reasoning.

c) Estimates are usually given with a margin of error. The margin of error is about 0.2 million (or about 200,000 likes). Based on this, would you be surprised if the true average number of likes was about 3.4 million likes? Explain.

b) Which would be more likely to give an estimate closer to the true average number of likes for all Instagram posts made by Selena Gomez in 2016, a random sample of 30 posts or a random sample of 100 posts? Explain your reasoning.

A random sample of 100 posts, because estimates tend to be closer to the truth when the sample size is larger.

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3.1 ± 0.2 or 2.9 to 3.3

Yes. According to our margin of error we think the true mean # of likes should be at most 3.3 million likes. 3.4 million likes is outside the margin of error.

Note:

The word "error" does not mean a mistake has bee made.

The margin of error compensates for the variability that results from taking a random sample from a population.

It does not account for a mistake made during data collection.

4.3 ....79, 93, 95, 96, 97, 99, 120

- Study pp.261-275
- Study Example/consider watching video of it's solution on page 274

Read all of p. 272 (if not pp.269-272)

Do..... 4.3 ......93, 95

and work on planning your

Response Bias Project

Thoughts
- You may want to start doing some Review for Tuesday's Test,
- Flashcards on the Student site.
- Chapter Review Problems.