Inference About Populations (later in the course)

Population

Inferences about Sampling

Infercences for Experiments

yesterday

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.

today's Goal

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.

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yesterday

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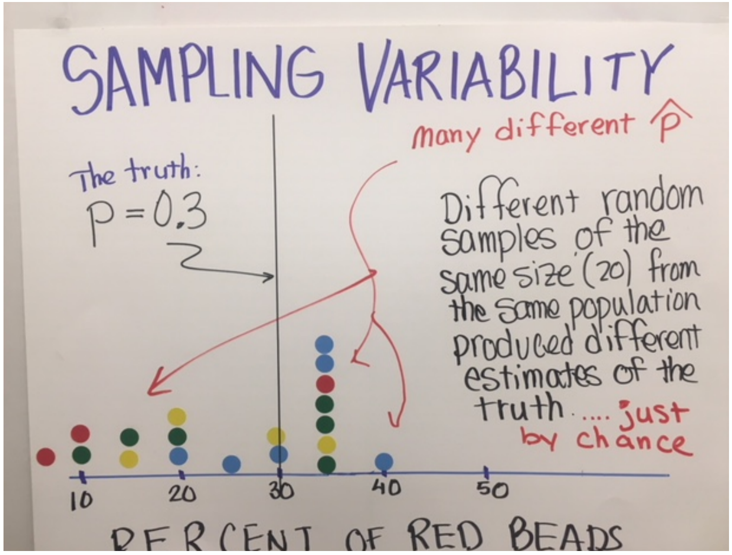
we sampled a proportion

$\hat{p}$



B. Inferences for Experiments ← today

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?

(2) Caffeine caused the change

there is some evidence that caffeine increases pulse rate.

	Change in pulse rate (Final pulse rate – Initial pulse rate)										Mean change
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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.

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?

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

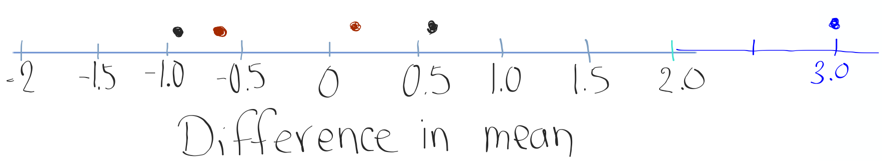
(2) Caffeine caused the change

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.



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

$\frac{1}{5} = .2$ or 20%

Interpret this percentage:
Assuming caffeine has no effect on the heart rate, there is a 20 % 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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Sampling Variability	Statistically Significant
Different samples yield different estimates. Larger samples produce more accurate estimates.	

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Sampling Variability	Statistically Significant
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Sampling Variability	Statistically Significant
• 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	When results from a study are too unusual to have occurred purely by chance.

Big Ideas: Inference for Experiments

Sampling Variability

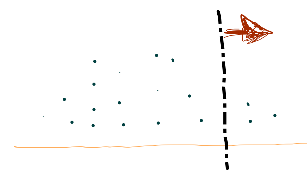
- Different samples yield different estimates.
- Larger samples produce more accurate estimates.
- Margin of Error (MOE) creates an interval of plausible values

Sample Estimate ± margin of Error

Statistically Significant

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

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.

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.

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.

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.

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.

See LCQ

4.3 ....94, 96, 97, 99