Introducing Inferential Statistics Early In The Course

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How's It Going?

www.thebluediamondgallery.com

In the Beginning …

business-through-adversity-kroselli.wikispaces.com

Teaching Intro Stats

- The way that we teach a modern statistics class has changed a great deal.
- That includes both the main goals of the course, as well as the tools we use to teach the course.

Then

- Formula Driven
- Computations

www.justintarte.com

Now

- Experimental Design
- Technology
- Interpretation of Results

learning.nd.edu

More Inference

the1709blog.blogspot.com

Engaging, Active Classroom

https://historytech.wordpress.com/2010/03/12/tip-of-the-week-interactive-lectures-i/

Active Learning Strategies

- Flipped Classroom
- Assessing to Learn
  "Clicker" Questions
  IF-AT (Immediate Feedback Assessment Technique)
- Class Activities and Projects

Impact of Technology in Intro Stats

http://tsaponar.blogspot.com/2013/05/my-students-prezi-presentation_8.html

Technology

- Technology allows the shift from computation to interpretation
- Technology can help students gain conceptual understanding of big picture ideas
- Powerful, yet easy for students to use

Technology

- What do we do with all the time that technology saves us?

My Inference Strategy

- Being able to perform inference and understand the inferential work of others is my primary goal.
- As often as possible, instruction/activities/projects should be aimed towards inference.
- How early in the course can we do this?

Three Inferential Strands

- I will be sharing three inferential scenarios that can be visited at multiple times throughout the course.
  - One Proportion
  - One Mean
  - Two Mean

Inference: One Proportion

- I tell my students that 30% of college students own an iPhone.
- Suppose we take a random sample of 50 students, and find that 20 of them own an iPhone.
- Would it be unusual to have 20 or more students who own an iPhone in a random sample of 50 students if 30% of all students own an iPhone?

Investigation 1: Coin Flipping

wikipedia.org

Technology

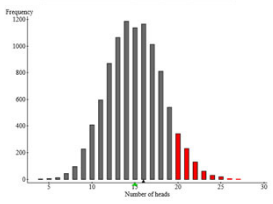
- I will be using StatCrunch, but there are many other options for technology.
- You can find plenty of applets at the Rossman Chance website: www.rossmanchance.com .

Investigation 1: Coin Flipping

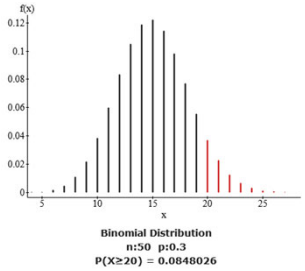
Investigation 1: Coin Flipping

Flipping 50 coins with probability of heads = 0.3

Event	Count	Total	Proportion
Number of heads >= 20	829	10000	0.0829



Investigation 2: Binomial Distribution



Investigation 3: One-Proportion Test

$$H_0 : p = 0.3$$
$$H_1 : p > 0.3$$

$$z_0 = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}}$$

Investigation 3: One-Proportion Test

Options

One sample proportion summary hypothesis test:
p : Proportion of successes
$H_0 : p = 0.3$
$H_A : p > 0.3$

Hypothesis test results:

Proportion	Count	Total	Sample Prop.	Std. Err.	Z-Stat	P-value
p	20	50	0.4	0.064807407	1.5430335	0.0614

Inference: One Mean

- The mean wait time at a drive-thru of a fast food restaurant is 90 seconds. A new system is implemented to reduce the wait time.
- Wait times (seconds) for 10 randomly selected customers:
  109 67 58 76 65 80 96 86 71 72
- Has the new system reduced the wait time?

Investigation 1: Bootstrapping

pixabay.com/fr/chaussure-de-randonn%C3%A9e-chaussures-25489/

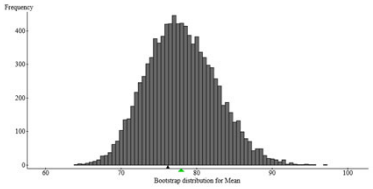
Investigation 1: Bootstrapping

- Wait times (seconds) for 10 randomly selected customers:
  109 67 58 76 65 80 96 86 71 72
- Select 10 values, with replacement, from this sample.
  Compute the mean for this sample.
  Repeat many times, examine the distribution.

Investigation 1: Bootstrapping

Bootstrap distribution for Mean with Times

n	Mean	Std. dev.	2.5th perc.	5th perc.	Median	95th perc.	97.5th perc.
10000	77.96	4.6	69.6	70.7	77.7	85.8	87.4



Investigation 1: Bootstrapping

- By the way …

One sample T confidence interval:
μ : Mean of variable

95% confidence interval results:

Variable	Sample Mean	Std. Err.	DF	L. Limit	U. Limit
Times	78	4.8671233	9	66.989802	89.010198

Investigation 2: Sign Test

profslusos.blogspot.com/2014/03/comparacao-entre-proposta-de-alteracao_6681.html

Investigation 2: Sign Test

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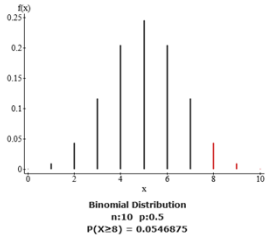
Investigation 2: Sign Test



Investigation 2: Sign Test

Options

Hypothesis test results:
median : median of Variable
H_0 : median = 90
H_A : median < 90

Variable	n	n for test	Sample Median	Below	Equal	Above	P-value
DriveThru	10	10	74	8	0	2	0.0547

Investigation 3: One Mean *t*-Test

$$t_0 = \frac{\bar{x} - \mu_0}{s / \sqrt{n}}$$

Investigation 3: One Mean *t*-Test

Options

One sample T hypothesis test:
μ : Mean of variable
H_0 : μ = 90
H_A : μ < 90

Hypothesis test results:

Variable	Sample Mean	Std. Err.	DF	T-Stat	P-value
DriveThru	78	4.8671233	9	-2.4655221	0.0179

Inference: Two Means

- Give students two sets of exam scores.
- Ask them to determine whether the two versions of the exam are of equal difficulty.

Inference: Two Means

A math instructor wrote two versions of the same test and believed them to be of equal difficulty. The first version was given to a random sample of 36 students, and the second version was given to a random sample of 41 students.
Your job is to help the instructor decide if the two tests were of equal difficulty, or if one of the exams was harder than the other. Here are the scores of the two versions.

(Data can be found as "Chapter 3 Project – 2 Tests" in the "Woodbury Math 21" StatCrunch group.)

Version A

91	79	82	86	88	88	82	88
88	64	98	90	75	60	93	80
86	82	63	77	82	69	79	73
57	92	82	85	94	77	74	90
53	68	62	77				

Version B

69	84	79	94	85	96	94	79
71	94	70	86	82	91	64	86
87	87	92	69	74	95	77	95
94	80	69	98	96	87	76	91
82	89	76	95	95	72	82	82
85							

Investigation 1: Descriptive Statistics

- Compare measures of central tendency
- Compare graphs
- Students look for evidence they think is significant
- No wrong answers … yet

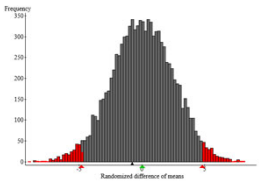
Investigation 2: Randomization

jcruz661.wikispaces.com/Dwire+February+Shapes

Investigation 2: Randomization

Randomized differences: Mean of Data (A - B)

Event	Count	Proportion of 10000 runs
-4.822222 or below	260	0.026
4.822222 or above	231	0.0231
Total	491	0.0491



Investigation 3: Two-Mean Test

Options

Two sample T hypothesis test:
μ_1 : Mean of A
μ_2 : Mean of B
$\mu_1 - \mu_2$: Difference between two means
$H_0 : \mu_1 - \mu_2 = 0$
$H_A : \mu_1 - \mu_2 \neq 0$
(without pooled variances)

Hypothesis test results:

Difference	Sample Diff.	Std. Err.	DF	T-Stat	P-value
$\mu_1 - \mu_2$	-4.8441734	2.3829201	68.490758	-2.0328728	0.0459

Other Tests

- Paired Difference Test
  - Bootstrapping
  - Wilcoxon Signed Ranks
- Two Proportion Test
  - Urn Sampling
  - Randomization
- ANOVA
  - Kruskal Wallis

Contact Info

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