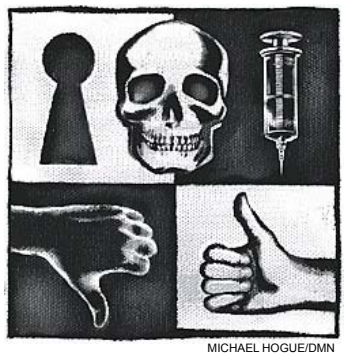
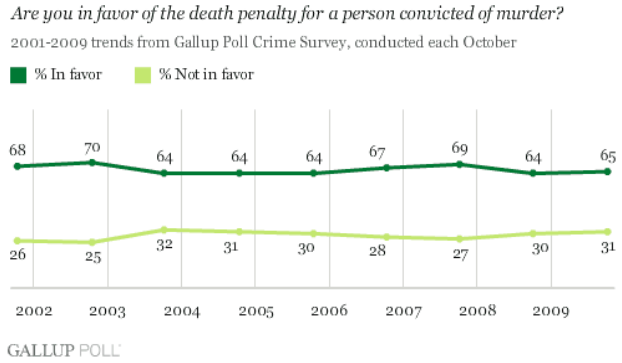


Chapter 19 – Confidence Intervals for Proportions

Gallup Poll: Death Penalty

- http://www.gallup.com/poll/123638/In-U.S.-Two-Thirds-Continue-Support-Death-Penalty.aspx



Death Penalty Continued…

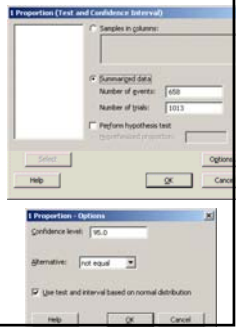
- Let's just focus on the most recent results…
  - 65% are in favor and 31% are opposed
  - Results are based on telephone interviews with 1,013 national adults, aged 18 and older, conducted Oct. 1-4, 2009.
- If they were only looking at 1,013 adults, what does the 65% mean? How representative is it of all national adults?
- The 65% is a sample proportion. In Chapter 18, we discussed a sampling distribution model for proportion.
  - What was it (draw it)? Under what assumptions?

A First Try at a Confidence Interval

- It's nice to have the model, but we don't know p (it's what we're trying to find).
- We can leave the model centered at some theoretical value of p, but we need a way to estimate the SD.
  - To estimate $SD\left(\hat{p}\right)$, we substitute $\hat{p}$ in for p. This gives the **standard error** $SE\left(\hat{p}\right)$.
- Consider our drawing of the model…
- So where does our value $\hat{p} = 0.65$ fall?
  - It's an observation from that normal model, so 95% of the time, it will fall within 2SE of p. And 95% of the time, p will be within 2SE of $\hat{p}$.
- We still don't know p, though. How can we use that information to get bounds on p?

The Confidence Interval in Minitab

- n = 1013, 65% support the death penalty for murder
- Find a 95% confidence interval
- Minitab > Stat > Basic Statistics > 1 Proportion
  - Number of Events = x = np
    = 1013 (0.65) = 658
    - The number of successes
    - Round to the nearest whole number
  - Number of Trials = n = 1013
  - Options
    - Enter Confidence Level
    - For Alternative, select "not equal"
    - Use … normal distribution
      - CHECK for answers that match the book
        - » I will leave it checked for demos.
      - UNCHECK for the exact answers



Just Checking…

Test and CI for One Proportion

```
Sample    X     N  Sample p          95% CI
1       658  1013  0.649556  (0.619280, 0.678959)
```

Test and CI for One Proportion

```
Sample    X     N  Sample p          95% CI
1       658  1013  0.649556  (0.620175, 0.678936)

Using the normal approximation.
```

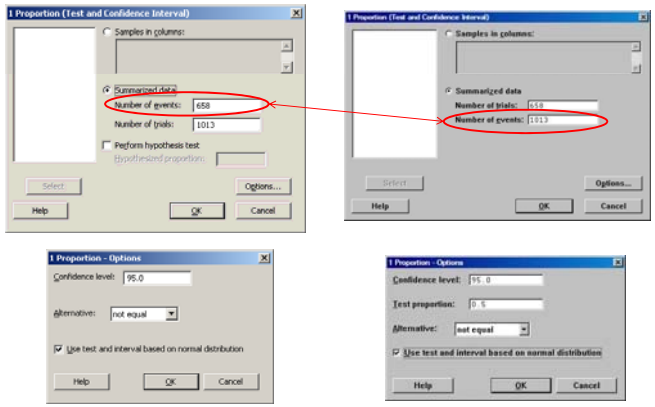
- Answer: We are 95% confident that between 62.0% and 67.9% of adults are in favor of the death penalty for a person convicted of murder.
- Questions
  - Can we conclude that the majority of adults favor the death penalty?
  - Can we conclude that at least 65% of adults favor the death penalty?

Margin of Error

- The **margin of error** (ME) is the distance from the endpoints of the interval to $\hat{p}$.
- The margin of error has the form (critical value) * (SE) where the critical values come from the Normal model with mean 0 and standard deviation 1.
  - For 95%, the critical value is 1.96.
  - For 90%, the critical value is 1.645
  - For 99%, the critical value is 2.576
- How can we use the output from Minitab to calculate the ME?

```
Sample    X     N  Sample p          95% CI
1       658  1013  0.649556  (0.620175, 0.678936)
```

Minitab 15 vs Minitab 14



Another Example: Crime Worries

- http://www.gallup.com/poll/123713/Two-in-Three-Americans-Worry-About-Identity-Theft.aspx

- 31% of U.S. adults worry frequently about being the victim of identity theft
- Results are based on telephone interviews with 1,013 national adults.
  1. Verify that we can construct a confidence interval.
  2. Find the margin of error
  3. Construct a 95% confidence interval.
  4. Interpret your results.
- In the same study, 19% of U.S. adults admitted to worrying frequently about having their car stolen or broken into
  1. Construct and interpret a 95% confidence interval.
  2. Compare your results to those for identity theft.

Just Checking…

Test and CI for One Proportion

Sample	X	N	Sample p	95% CI
1	314	1013	0.309970	(0.281491, 0.338450)

- Identity Theft
  1. Randomization, 10% condition, success/failure
  2. ME = 0.028
  3. 28.1% < p < 33.8%
  4. We are 95% confident that between 28.1% and 33.8% of U.S. adults frequently worry about being the victim of identity theft.

Test and CI for One Proportion

Sample	X	N	Sample p	95% CI
1	192	1013	0.189536	(0.165401, 0.213672)

- Car Stolen/Broken Into
  1. 16.5% < p < 21.4%. We are 95% confident that between 16.5% and 21.4% of U.S. adults frequently worry about having their car stolen or broken into.
  2. The proportion who worry about having their car stolen/broken into is less than the proportion who worry about being the victim of identity theft.

Changing the Level of Confidence

- A little common sense…
  - One weatherman predicts between 4" and 8" of snow. Another weatherman predicts between 5" and 6" of snow.
    - Which is more reliable?
  - I say there that between 1% and 50% of the cars in the parking lot are red. Joe says it's between 22% and 23%.
    - Which estimate is more likely to contain the true proportion of red cars in the parking lot?
- What will happen as we increase the level of confidence from 95% to 99%?
- What is the effect of having a larger sample size?

Check Your Conclusions…

- Stolen Cars…
  - 19% of U.S. adults admitted to worrying frequently about having their car stolen or broken into
  - Results are based on telephone interviews with 1,013 national adults.
  - We found the 95% confidence interval to be 16.6% < p < 21.5%

1. Find the 99% confidence interval.
2. Find the 95% confidence interval, using 10,000 as the sample size.

Just Checking…

- Original 95% CI: 16.5% < p < 21.4%

Test and CI for One Proportion

```
Sample    X     N  Sample p         99% CI
1       192  1013  0.189536  (0.157817, 0.221255)

Using the normal approximation.
```

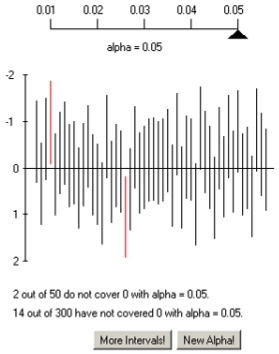
Test and CI for One Proportion

```
Sample     X      N  Sample p         95% CI
1       1900  10000  0.190000  (0.182311, 0.197689)

Using the normal approximation.
```

Interpreting 95% Confidence Intervals

- On average (long run), 95% of CIs constructed from samples will contain the TRUE value of the parameter
- 5% won't
- http://www.stat.sc.edu/~west/javahtml/ConfidenceInterval.html
  - Alpha = 0.05 ↔ 95% CI
  - Alpha = 0.01 ↔ 99% CI
  - Alpha = 0.10 ↔ 90% CI



Class Work

- To get credit, it is your responsibility to get checked off.
  1. Chapter 19 Handout
     - Checking solutions? No pens in the front!

Homework

- Textbook/Routine Homework
  - Due Next Week (25% chance of collection)
  1. Read Chapter 19
  2. Pg 503-507: #3, 5, 7, 11, 13, 15, 17, 21, 25, 27