

Announcement

Help sessions

Wednesday 4:00-5:00PM at Lawson 221.

- **The Third Hour Exam:**
April 4, Friday in class.

March 21, 2008

Margin of Error

The **margin of error** announced by most national samples says how close to the truth about the population the sample result would fall in 95% of all samples drawn by the method used to draw this one sample

We say that we have 95% confidence that the truth about the population lies within the margin of error.

Example

“A new poll shows that 60% of all Americans approve of the way the president is handling his office. The **margin of error** for the poll is plus or minus 3%”

It means:

the true percentage is almost certain (95%) to be within the 57%-63% range.

The Quick Method for Margin of Error

Use the sample percent from a simple random sample of size n to estimate an unknown population percent. The margin of error for 95% confidence is roughly equal to $100\sqrt{n}$

Example

A poll asked 956 licensed drivers whether they supported a nationwide lowering of the drunk driving limit to 0.08% BAC (blood alcohol content), and 72% said they did. Use the quick method to estimate the margin of error for conclusion about all Licensed drivers.

- A) 30.9%
- B) 3.2%
- C) 32.3%
- D) 11.8%

$$\frac{100}{\sqrt{n}} = \frac{100}{\sqrt{956}} = \frac{100}{30.919} = 3.23$$

Sample Proportion

Question: what is the percentage of Americans approve of the way the president is handling his office?

True proportion = $\frac{\text{The number of Americans who say yes}}{\text{Total of all Americans}}$

Sample proportion = $\frac{\text{The number of samples who say yes}}{\text{sample size}}$

In our textbook P stands for true proportion.
 \hat{P} stands for sample proportion.

An Example

Suppose you conduct a telephone poll of 1250 people, asking them whether or not they favor mandatory sentencing for drug related crimes. If 580 people say "yes," what is the **sample proportion** \hat{p} of people in favor of mandatory sentencing?

Answer: $\hat{p} = \frac{580}{1250} = .464 = 46.4\%$

Old Exam Question

A random sample of 300 car owners in Louisville indicated that 36 had full insurance coverage on glass breakage for their car, with no deductible amount. In this example, What is the **sample proportion**?

__A. 83%

__B. 36%

__C. 8.3%

D. 12%

Answer: $\frac{36}{300} = 0.12 = 12\%$

Standard Deviation of Sample Proportion

For a given sample size n , the sample proportion

- varies with the sample
- is closer to a normal distribution when n is large
- the mean is the true proportion p
- the standard deviation of the sampling distribution is

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

Example

Suppose you conduct a telephone poll of 1250, asking them whether or not they favor mandatory sentencing for drug related crimes. If the true population proportion is $p=45\%$, what is the standard deviation of the sampling distribution?

Answer:

$$s_{\hat{p}} = \sqrt{\frac{p(1-p)}{n}} = \sqrt{\frac{45(1-0.45)}{1250}} = \sqrt{0.0198} = 0.14071247 = 14.07\%$$

Confidence Intervals

Choose an SRS of size n from a large population that contains an unknown percent p of successes. A **95% confidence interval for p** is

$$\hat{p} \pm 2\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$$

Here \hat{p} is the proportion of successes in the sample. Both p and \hat{p} are measured in percent.

Example: Risky Behavior in the Age of AIDS

The National AIDS Behavior Surveys interviewed a random sample of 2673 adult heterosexuals. Of these, 170 had more than one sexual partner in the past year. The sample proportion who admit to multiple partners is

$$\hat{p} = \frac{170}{2673} = 6.36\%$$

A **95% confidence interval for the proportion p of all adult heterosexuals with multiple partners is therefore**

$$\hat{p} \pm 2\sqrt{\frac{\hat{p}(1-\hat{p})}{n}} = 6.36\% \pm 2\sqrt{\frac{6.36\%(1-6.36\%)}{2673}} = 6.36\% \pm 0.94\% = 5.42\% \text{ to } 7.30\%$$

Old Exam Question

In a sample of 1100 voters in a 2-candidate race, 55% say they intend to vote for the Democrat candidate. What is the 95% confidence interval for the proportion who will vote for the Democrat?

- ___A. 45% to 65%
- ___B. 47% to 53%
- ___C. 53.5% to 56.5%
- ___D. 52% to 58%

$$\begin{aligned} \hat{p} \pm 2\sqrt{\frac{\hat{p}(1-\hat{p})}{n}} \\ = 55\% \pm 2\sqrt{\frac{55\%(1-55\%)}{1100}} \\ = 55\% \pm 2 \times 1.5\% = 55\% \pm 3\% \end{aligned}$$

Population Mean and Sample Mean

Example: The second hour exam of last spring for math 113 is Mean = 9.43, standard deviation = 2.91

Population Mean = 9.43

If we pick 10 students and calculate the mean, it is called a sample mean.

If the population is very large, it is difficult to get the population mean.

Question: can we use sample means to approximate the population mean?

Estimating a Population Mean

Suppose that a population has unknown mean μ and known standard deviation σ . Draw a simple random sample of size n from this population and calculate the sample mean \bar{x} . A 95% confidence interval for the population mean μ is

$$\bar{x} \pm 2 \frac{\sigma}{\sqrt{n}}$$

Example

Example: we continue our previous example:
Mean = 9.43, standard deviation = 2.91

Pretend we don't know the Mean and only know the standard Deviation 2.91. Now we pick 10 students at random and their score is: **07 09 10 06 05 11 14 08 09 11**.

The sample mean $\bar{x} = \frac{7+9+10+6+5+11+14+8+9+11}{10} = 9$

$$\bar{x} \pm 2 \frac{\sigma}{\sqrt{n}} = 9 \pm 2 \frac{2.91}{\sqrt{10}} = 9 \pm 1.84$$

A 95% confidence interval for the mean is (7.16, 10.84)

Old Exam Question

The standard deviation of the thickness of screw in a shipment is 0.04 mm. A sample of 16 plates is chosen and found to have a mean thickness of 2.48 mm. Find a 95% confidence interval for the true mean thickness of plates in the shipment.

- ___A. 2.47 to 2.49 mm
- ___B. 2.40 to 2.56 mm
- ___C. 2.43 to 2.62 mm
- ___D. 2.46 to 2.50 mm

$$\bar{x} \pm 2 \frac{\sigma}{\sqrt{n}} = 2.48 \pm 2 \frac{0.04}{\sqrt{16}} = 2.48 \pm 0.02$$

- Instructional class meets

Monday and Friday 8:00-8:50 AM.

- Recitation sessions meet:

- section 1 Tues 8:00AM, NKRS 156
- section 2 Wed 8:00AM, AG 153
- section 4 Tues 9:00AM, NKRS 156
- section 6 Tues 10:00AM, NKRS 156