Chapter 8.1 & 8.2
Quiz Review

Name Key
Date ______ Hour ______

1. A consumer watchdog organization estimates the mean weight of 1-ounce "Fun-Size" candy bars to see if customers are getting full value for their money. A random sample of 25 bars is selected and weighed, and the organization reports that a 90% confidence interval for the true mean weight of the candy bars is 0.992 to 0.998 ounces.

(a) What is the point estimate from this sample?

Point estimate is sample mean ($\bar{x}$)

$$\bar{x} = \left(\frac{.992 + .998}{2}\right) = .995 \text{ oz}$$

(b) What is the margin of error?

$$M.E = \left(\frac{.998 - .992}{2}\right) = .003 \text{ oz}$$

(c) Interpret the 90% confidence *interval* 0.992 to 0.998 in the context of the problem.

We are 90% confident that the interval from 0.992 to 0.998 captures the true mean weight of all 1oz Fun Size candy bars.

(d) Interpret the confidence *level* of 90% in the context of the problem.

If we make many 90% confidence intervals, we expect about 90% to capture the population weight of 1oz Fun Size candy bars.

2. A manufacturer of flashlights wants to know how well one of their newer styles is selling in a chain of large home-improvement stores. They select a simple random sample of 20 stores, record how many of the flashlights were sold in a 30-day period, and construct a 95% confidence interval for the mean number of flashlights sold.

Random, Independent, Normal

(a) Discuss whether this study meets the necessary conditions for constructing a confidence interval. If you think one of the conditions has not been met, what additional information would be required or what change in the study would you recommend?

Random: SRS of 20 stores ✓ Independent (10%): 10 (20) ≥ 200 Population of large chain home improvement stores

Reasonable to assume ✓

Normal Condition: We do not know if the shape of the population is Normal, so we must use the Central Limit Theorem ($n \geq 30$). Since $20 \not\geq 30$, this samples fails CLT and we can not infer it is Normal.

To meet this condition we would need to know that population is Normal, or increase the sample size to 30 or greater.

(b) If, instead of constructing a 95% confidence interval, the flashlight manufacturer constructed a 98% confidence interval, would the 98% interval be wider, narrower, or the same width as the 95% interval? Explain.

A 98% interval would be wider than the 95% interval b/c we will have a larger margin of error.

(c) How would the width of confidence interval change if the flashlight manufacturer took a larger sample? Explain.

If the sample size is larger, there is less variability, which means the standard deviation would be smaller and this would make the confidence interval narrower.

You will need to study the 4 step process for the quiz. This is one example. You will get the template on the quiz (but not the chapter test, so start to learn it) You can practice the 4-step problems from your homework to help you study.

3. A simple random sample of 1100 males aged 12 to 17 in the United States were asked whether they played massive multiplayer online role-playing games (MMORPGs): 775 said that they did. We want to use this information to construct a 95% confidence interval to estimate the proportion of all U.S. males aged 12 to 17 who play MMORPGs.

$\hat{p} = \frac{775}{1100} \approx .705$

a) Use the 4 step process to construct the 95% confidence interval.

STATE: State the parameter you want to estimate and the confidence level.

We want to estimate the true proportion of U.S. males aged 12 to 17 in the U.S. who play MMORPG's at a 95% confidence level.

PLAN: Identify the appropriate inference method and check conditions.

Name of procedure: 1 sample z interval for p.

Check conditions:

① Random: a SRS of 1100 males chosen ✓

② Independent (10%)
$10(1100) < $ pop of US Males aged 12 to 17 who play MMORPG
Reasonable to assume ✓

③ Random (Large Counts)
$n(\hat{p}) \geq 10$
$1100\left(\frac{775}{1100}\right) \geq 10$
$775 \geq 10$ ✓ # of successes
$n(1-\hat{p}) \geq 10$
$1100\left(\frac{325}{1100}\right) \geq 10$
$325 \geq 10$ ✓ # of failures

DO: If the conditions are met, perform the calculations.

General Formula: Point Estimate ± Margin of Error

Specific Formula: $\hat{p} \pm z^* \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$

$z^*_{95\%} = \text{invNorm}(.025) = 1.96$

Work:

$.705 \pm 1.96\sqrt{\frac{(.705)(.295)}{1100}}$

$.705 \pm .027$

Answer: $(.678, .732)$

CONCLUDE: Interpret your interval in the context of the problem.
Interpret:

We are 95% confident the interval from .678 to .732 captures the true proportion of all U.S. males aged 12 to 17 who play MMORPGs.

b) Suppose you wanted to estimate the proportion of 12-to-17 year-old males who play MMORPG's with 95% confidence to within ± 2%. Calculate how large a sample you would need.

$$ME \geq z^* \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$$

$$.02 \geq 1.96\sqrt{\frac{(.705)(.295)}{n}}$$

$$\left(\frac{.02}{1.96}\right) \geq \sqrt{\frac{.207975}{n}}$$

$$\left(\frac{.02}{1.96}\right)^2 \geq \frac{.207975}{n}$$

$$n \geq \frac{.207975}{\left(\frac{.02}{1.96}\right)^2}$$

$$n \geq 1997.4$$

$$\boxed{n = 1,998}$$

c) If you wanted to have a margin of error of ±2% with 99% confidence, would your sample have to be larger, smaller, or the same size as the sample in part (b)? Explain.

$$z^*_{99\%} = \text{invNorm}(.005) = 2.576$$

$$.02 \geq 2.576\sqrt{\frac{(.705)(.295)}{n}}$$

$$\frac{.02}{2.576} \geq \sqrt{\frac{.207975}{n}}$$

$$\left(\frac{.02}{2.576}\right)^2 \geq \frac{.207975}{n}$$

$$n \geq \frac{.207975}{\left(\frac{.02}{2.576}\right)^2}$$

$$n \geq 3450.2$$

$$\boxed{n = 3451}$$

Sample would be larger. Increasing sample size reduces variability which increases confidence in the interval's ability to capture the parameter.

d) This poll was conducted through email. Explain how undercoverage could lead to a biased estimate in this case, and speculate about the direction of the bias.

A poll conducted through email could lead to undercoverage by leaving out individuals who don't go online often or at all. This would probably cause our sample to overestimate the proportion of males aged 12 to 17 in the U.S. who play MMORG's.

Use the 4 Step Process

4. Mrs. Cowells was an all-star basketball player in high school. To prove that she still has skills, she took 50 free throws and made 31 of them. Think of these 50 shots as being a random sample of all the free throws she has ever taken. Find a 99% confidence interval for the true proportion of free throws Mrs. Cowells would make.

STATE: State the parameter you want to estimate and the confidence level.

We will estimate the true proportion p of free throws Mrs. Cowells made at a 99% confidence interval.

PLAN: Identify the appropriate inference method and check conditions.

$\hat{p} = \frac{31}{50} = .62$

Name of procedure: One sample z-interval for p

Check conditions:

Random

Random sample of 50 shots ✓

Independent (10%)

10(50) < all free throws Mrs. C ever took

reasonable to assume ✓

Normal Condition (Large Counts)

$n(\hat{p}) \geq 10$

$50(.62) \geq 10$

$31 \geq 10$ ✓

$n(1-\hat{p}) \geq 10$

$50(.38) \geq 10$

$19 \geq 10$ ✓

DO: If the conditions are met, perform the calculations.

General Formula: Point Estimate ± Margin of Error

Specific Formula: $\hat{p} \pm z^* \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$

Work:

$z^*_{99\%} = \text{invNorm}(.005) = 2.576$

$.62 \pm 2.576\sqrt{\frac{(.62)(.38)}{50}}$

$.62 \pm .177$

Answer: (.443, .797)

CONCLUDE: Interpret your interval in the context of the problem.

Interpret: We are 99% confident that the true proportion of free throws Mrs. Cowells made is captured by the interval from .443 to .797.

(Make sure to review your notes and homework to help you study!)