

Directions: *Work on these sheets. Answer completely, but be concise.*

Part 1: Multiple Choice. *Circle the letter corresponding to the best answer.*

1. In a study of the effects of acid rain, a random sample of 100 trees from a particular forest is examined. Forty percent of these show some signs of damage. Which of the following statements is correct?
 - (a) 40% is a parameter
 - (b) 40% is a statistic
 - (c) 40% of all trees in the forest show some signs of damage
 - (d) More than 40% of the trees in the forest show some signs of damage
 - (e) Less than 40% of the trees in the forest show some signs of damage

2. Refer to the previous problem. Which of the following statements is correct?
 - (a) The sampling distribution of the proportion of damaged trees is approximately normal
 - (b) If we took another random sample of trees, we would find that 40% of these would show some signs of damage
 - (c) If a sample of 1000 trees was examined, the variability of the sample proportion would be larger than in a sample of 100 trees
 - (d) This is a comparative experiment
 - (e) None of the above

3. Which of the following statements is (are) true?
 - I. The sampling distribution of \bar{x} has standard deviation σ/\sqrt{n} even if the population is not normally distributed.
 - II. The sampling distribution of \bar{x} is normal if the population has a normal distribution.
 - III. When n is large, the sampling distribution of \bar{x} is approximately normal even if the population is not normally distributed.
 - (a) I and II
 - (b) I and III
 - (c) II and III
 - (d) I, II, and III
 - (e) None of the above gives the correct set of responses.

4. Suppose we are planning on taking an SRS from a population. If we double the sample size, then $\sigma_{\bar{x}}$ will be multiplied by:
 - (a) $\sqrt{2}$
 - (b) $1/\sqrt{2}$
 - (c) 2
 - (d) 1/2
 - (e) 4

5. If a statistic used to estimate a parameter is such that the mean of its sampling distribution is different from the true value of the parameter being estimated, the statistic is said to be
- (a) Random
 - (b) Biased
 - (c) A proportion
 - (d) Unbiased
 - (e) None of the above. The answer is _____.
6. A machine is designed to fill 16-ounce bottles of shampoo. When the machine is working properly, the mean amount poured into the bottles is 16.05 ounces with a standard deviation of 0.1 ounce. If four bottles are randomly selected each hour and the number of ounces in each bottle is measured, then 95% of the observations should occur in which interval?
- (a) 16.05 and 16.15 ounces
 - (b) $-.30$ and $+.30$ ounces
 - (c) 15.95 and 16.15 ounces
 - (d) 15.90 and 16.20 ounces
 - (e) None of the above
7. Dr. Stats plans to toss a fair coin 10,000 times in the hope that it will lead him to a deeper understanding of the laws of probability. Which of the following statements is true?
- (a) It is unlikely that Dr. Stats will get more than 5000 heads.
 - (b) Whenever Dr. Stats gets a string of 15 tails in a row, it becomes more likely that the next toss will be a head.
 - (c) The fraction of tosses resulting in heads should be close to $1/2$.
 - (d) The chance that the 100th toss will be a head depends somewhat on the results of the first 99 tosses.
 - (e) All of the above statements are true.

Part 2: Free Response *Communicate your thinking clearly and completely.*

A study of the health of teenagers plans to measure the blood cholesterol level of an SRS of youth of ages 13 to 16 years. The researchers will report the mean \bar{x} from their sample as an estimate of the mean cholesterol level μ in this population.

8. Explain to someone who knows no statistics what it means to say that \bar{x} is an “unbiased” estimator of μ .
9. The sample result \bar{x} is an unbiased estimator of the population truth μ no matter what size SRS the study chooses. Explain to someone who knows no statistics why a large sample gives more trustworthy results than a small sample.

In a test for ESP (extrasensory perception), the experimenter looks at cards that are hidden from the subject. Each card contains either a star, a circle, a wave, or a square. As the experimenter looks at each of 20 cards in turn, the subject names the shape on the card.

10. Describe the design of a simulation to estimate the proportion of correct guesses assuming the subject does *not* have ESP using the partial random digits table below. Then perform the simulation.

3 5 4 7 6 5 5 9 7 2 3 9 4 2 1 6 5 8 5 0 0 4 2 6 6 3 5 4 3 5
6 0 9 4 0 7 2 0 2 4 1 7 8 6 8 2 4 9 4 3 6 1 7 9 0 9 0 6 5 6

When the ESP study described above discovers a subject whose performance appears to be better than guessing, the study continues at greater length. The experimenter looks at many cards bearing one of five shapes (star, square, circle, wave, and cross) in an order determined by random numbers. The subject cannot see the experimenter as he looks at each card in turn, in order to avoid any possible nonverbal clues. The answers of a subject who does not have ESP should be independent observations, each with probability $1/5$ of success. We record 1000 attempts.

11. What are the mean and standard deviation of the *proportion* of successes among the 1000 attempts?
12. What is the probability that a subject without ESP will be successful in at least 24% of the 1000 attempts?
13. The researcher considers evidence of ESP to be a proportion of successes so large that there is only probability 0.01 that a subject could do this well or better by guessing. What proportion of successes must a subject have to meet this standard?

Ch 9 Review

(1) b (2) a (3) d (4) b (5) b (6) c (7) c (8) In repeated samples, the values of \bar{x} will center on the true population mean μ . (9) The values of \bar{x} in larger samples will vary less than in smaller samples. (10) Since the probability that a subject guesses correctly on a particular card is 0.25, let the digits 01 – 25 = “correct guess” and 26 – 00 = “incorrect guess”. The underlined digits represent the correct guesses for this subject. The proportion of correct guesses is $\hat{p} = 5/20 = 0.25$.

3 5 4 7 6 5 5 9 7 2 3 9 4 2 1 6 5 8 5 0 0 4 2 6 6 3 5 4 3 5
 6 0 9 4 0 7 2 0 2 4 1 7 8 6 8 2 4 9 4 3 6 1 7 9 0 9 0 6 5 6

(11) Mean: $p = 0.2$; Standard deviation: 0.0126

(12) $P(\hat{p} \geq 0.24) = P(z \geq (0.24 - 0.2)/0.0126) = P(z \geq 3.17) = 7.6 \cdot 10^{-4}$

(13) $2.33 = (\hat{p} - 0.20)/0.0126 \rightarrow \hat{p} = 0.229$.

(14) $P(X > 140) = P(z > (140 - 125)/10) = P(z > 1.5) = 0.0668$.

(15) Center: $\mu_{\bar{x}} = 125$; Spread: $\sigma_{\bar{x}} = 5$; Shape: normal (since parent population is normal).

(16) $P(\bar{x} \geq 140) = P(z \geq (140 - 125)/5) = P(z \geq 3) = 0.0013$.

(17) $1.645 = (\bar{x} - 125)/5 \rightarrow \bar{x} = 133.23$.