

Show all work and reasoning.

1. Professional football players in the NFL have a distribution of salaries that is unimodal and heavily skewed to the larger salaries - the mean is \$1.9 million, however this is distorted by a small number of players who made an insanely large amount of money (such as Peyton Manning, who in 2014 earned \$15 million). In fact, the median salary for NFL players in 2014 was "only" \$770,000. The standard deviation for NFL salaries is \$2.34 million.
 - a) Suppose you randomly select 150 players from the NFL and created a dot plot of their salaries. What is the likely shape of the distribution of those 150 salaries?

 - b) Now suppose that you repeatedly select samples (with replacement) of 150 NFL players, and for each sample, you record the mean salary of the 150 players selected. If you repeated this procedure for a large number of samples, what is the likely shape of the distribution of mean salaries for random samples of 150?

 - c) Find the mean and standard deviation for the distribution of the sample mean salaries for random samples of 150 players.

2. In order to check if their cupcake-making machines are operating within specifications, Cutie Cupcakes analyzes their cupcakes by the mean weight of a set of 6 cupcakes. The weights of individual Cutie Cupcakes are normally distributed, with a mean weight of 3.1 ounces and standard deviation of 0.25 ounces. Let \bar{x} represent the mean weight of six randomly selected Cutie Cupcakes. About the middle 95% of all values of \bar{x} would fall between what two values?

3. Podunk Research reports that this past Thanksgiving, the mean weight for Thanksgiving turkeys was 30 pounds. Assuming that Thanksgiving turkey weights are approximately normally distributed, which of the following is MORE likely? Justify your answer. *(You may wish to use drawings/diagrams to help justify your answer)*
 - i. A random sample of 15 turkeys having a mean weight that is greater than 34 pounds
 - or
 - ii. A random sample of 50 turkeys having a mean weight that is greater than 34 pounds

8. Cutting-edge scientific research suggests that the true population proportion of high school seniors that develop the horrible disease known as **SENIORITIS** is 44%. Your teacher, however, believes* that this proportion is much higher for AP Statistics students (**BUT NOT YOU GUYS OF COURSE... COUGH, COUGH**).

a) Let's assume that the 44% estimate is indeed the truth. Describe the distribution for the sample proportion of seniors that develop senioritis for random samples of 158 students.

Hint: you need to describe the shape (approximately normal? and why?), center (mean), and spread (standard deviation).

b) Suppose we take a random sample of 158 seniors that are taking AP Statistics (which, for the purposes of this problem, we will consider to be a representative sample of high school seniors). Using the information calculated in part (a), what is the probability that at least 50% of that sample will develop **SENIORITIS**?

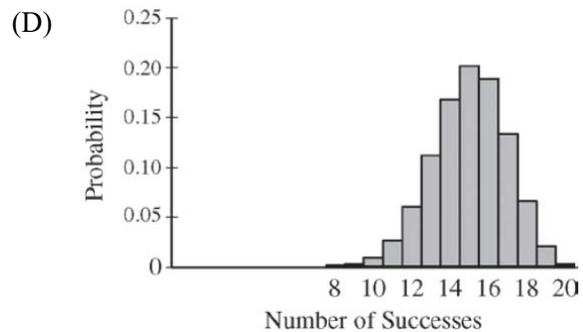
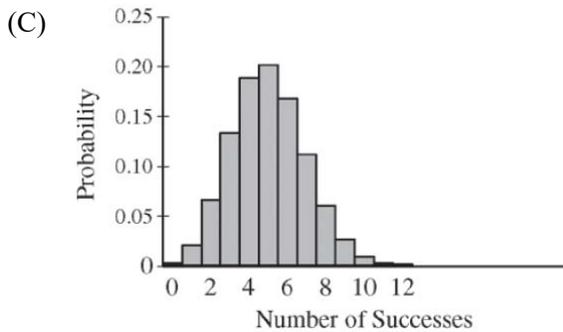
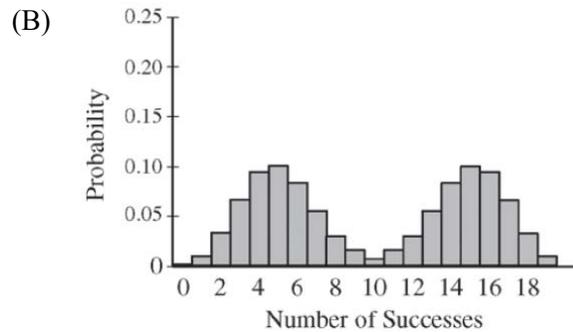
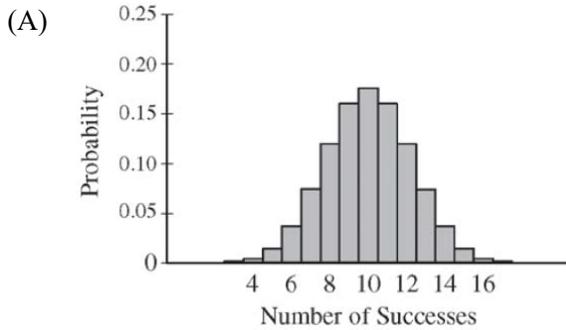
Be sure to verify any conditions that are necessary for your analysis.

9. The distribution of scores for persons over 26 years of age on the Wechsler Adult Intelligence Scale (WAIS) is approximately symmetric and unimodal with mean 100 and standard deviation of 15. The WAIS is one of the most common “IQ” tests for adults.
- a) Suppose we take a random sample of 60 adults. Describe the distribution of sample mean scores for random samples of 60 adults. (*Again, you need to describe the shape, mean, and standard deviation*)
- b) What is the probability that the mean WAIS score of a *random sample* of 60 adults who take the WAIS test is at least 102? *Be sure to verify any conditions that are necessary for your analysis.*

12. _____ Let X be a random variable that has a skewed distribution with mean $\mu = 10$ and standard deviation $\sigma = 10$. Based on random samples of size 400, the sampling distribution of \bar{x} is

- A) approximately normal with mean 10 and standard deviation 0.5
- B) approximately normal with mean 10 and standard deviation 10
- C) highly skewed with mean 10 and standard deviation 10
- D) highly skewed with mean 10 and standard deviation 5
- E) highly skewed with mean 10 and standard deviation 0.5

13. _____ Which of the following graphs represents a binomial distribution with $n = 20$ and $p = 0.75$?



14. _____ In the design of a survey, which of the following best explains how to reduce sampling variability?

- A) Increase the sample size.
- B) Decrease the sample size.
- C) Randomly select the sample.
- D) Increase the number of questions in the survey.
- E) Carefully word and field-test survey questions.

15. _____ Which of the following pairs of sample size n and population proportion p would produce the greatest standard deviation for the sampling distribution of a sample proportion \hat{p} ?

- A) $n = 500$ and p close to 0
- B) $n = 500$ and p close to 1
- C) $n = 500$ and p close to 0.5
- D) $n = 200$ and p close to 0
- E) $n = 200$ and p close to 0.5

16. _____ A researcher plans a study to examine the depth of belief in God among the adult population. He obtains a simple random sample of 100 adults as they leave church one Sunday morning. All but one of them agrees to participate in the survey. Which of the following are true statements?
- I. Proper use of chance as evidenced by the simple random sample makes this a well-designed survey.
 - II. The high response rate makes this a well-designed survey.
 - III. Selection bias makes this a poorly designed survey.
- A) I only
 - B) II only
 - C) III only
 - D) I and II
 - E) None of these
17. _____ A population of Jelly Blubbers has a mean length of 19.4 millimeters. A group of statistics students tags each blubber with a number, then uses a random number generator to select a random sample of 10 blubbers. The mean size observed in this sample of blubbers was 20.9 mm. Assuming that these students knew how to properly use a random number generator, and that the measurements were collected properly, what is the explanation for this difference between the observed mean and the expected mean?
- A) Bias
 - B) Sampling variability
 - C) Confounding
 - D) Placebo effect
 - E) Extrapolation
18. _____ Based on records kept at a local convenience store, the distribution of gallons of water purchased by customers in the days leading up to a tropical storm is skewed to the right with mean 7 gallons and standard deviation 3 gallons. A random sample of 49 customer receipts was selected, and the sample mean number of gallons was recorded. Suppose the process of selecting a random sample of 49 receipts and recording the sample mean number of gallons was repeated for a total of 100 samples. Which of the following is the best description of a dotplot created from the 100 sample means?
- A) The dotplot is skewed to the right with mean 7 gallons and standard deviation 3 gallons.
 - B) The dotplot is skewed to the right with mean 7 gallons and standard deviation 0.30 gallon.
 - C) The dotplot is skewed to the right with mean 7 gallons and standard deviation 0.43 gallon.
 - D) The dotplot is approximately normal with mean 7 gallons and standard deviation 0.30 gallon.
 - E) The dotplot is approximately normal with mean 7 gallons and standard deviation 0.43 gallon.
19. _____ A large sampling bowl contains thousands of small beads of two different colors: orange and white. Suppose that exactly 44% of all of the beads in the bowl are orange (and the rest are white). Let \hat{p} represent the sample proportion of orange beads in a random sample of 25 beads. Which of the following statements is true regarding the sampling distribution of \hat{p} ?
- A) For random samples of size 25, about 95% of all \hat{p} values will be between 0.241 and 0.639.
 - B) For random samples of size 25, about 95% of all \hat{p} values will be between 0.341 and 0.539.
 - C) For random samples of size 25, about 95% of all \hat{p} values will be between 0.142 and 0.738.
 - D) For random samples of size 25, about 95% of all \hat{p} values will be between 0.025 and 0.975.
 - E) The normal model cannot be used to make any predictions about the middle 95% of the sampling distribution of \hat{p} since the sample size is not larger than 30.

AP STATISTICS

Review Unit VI – Probability Models and Sampling Distributions

ANSWERS

1. a) Skewed to the right (this is asking about a SINGLE sample... not the distribution of means for a large number of samples)
b) Approximately normal
c) Mean = \$1.9 million, SD = \$0.191 million
2. between 2.9 ounces and 3.3 ounces
3. (i) is more likely. A smaller sample size results in a smaller z-score for the observed mean weight...
4. About 42
5. 100
6. a) x4
b) x9
c) x100
7. a) 7. Probability of $6/36$
b) 2 or 12. Each have a $1/36$ probability.
8. a) Approximately normal, mean = 0.44, SD = 0.0395
b) 0.0643
9. a) Approximately normal, mean = 100, SD = 1.936
b) 0.1508
10. a) Approximately normal, $E(W) = 72.9$ ounces, $SD(W) = 1.84$
Note: "W" is really $(A_1 + A_2 + A_3 + A_4 + P_1 + P_2 + P_3 + P_4 + P_5 + P_6 + P_7 + P_8 + \text{Basket})$... which is not the same as $(4A + 8P + \text{Basket})$
b) 0.0007
11. a) Mean = 58; SD = 19.925
b) Mean = 70; SD = 30
c) Mean = 146; SD = 64.4127
Note: The random variable $(3X - 5Y)$ does not have the same standard deviation as $(X_1 + X_2 + X_3 + Y_1 + Y_2 + Y_3 + Y_4 + Y_5)$.
12. A
13. D
14. A
15. E
16. C
17. B
18. E
19. A