

## Chapter 9 - Sampling Distribution Review

**Multiple Choice**

1. Which of the following statements are true?
  - I. The larger the sample, the larger the spread in the sampling distribution.
  - II. Provided that the population size is significantly greater than the sample size, the spread of a sampling distribution is about the same no matter what the population size.
  - III. Bias has to do with the center, not the spread of the sampling distribution.
  - (a) I and II
  - (b) I and III
  - (c) II and III
  - (d) I, II, and III
  - (e) None of the above gives the complete set of true responses.
  
2. Which of the following statements are true?
  - I. Sample parameters are used to make inferences about population statistics.
  - II. Statistics from smaller samples have more variability.
  - III. Parameters are fixed, while statistics vary depending on which sample is chosen.
  - (a) I and II
  - (b) I and III
  - (c) II and III
  - (d) I, II, and III
  - (e) None of the above gives the complete set of true responses.
  
3. Which of the following statements are true?
  - I. The sampling distribution of  $\bar{x}$  has standard deviation  $\frac{\sigma}{\sqrt{n}}$  even if the population is not normally distributed.
  - II. The sampling distribution of  $\bar{x}$  is normal if the population had 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 complete set of true responses.

4. Which of the following statements are true?
- I. The mean of the set of sample means varies inversely as the square root of the size of the samples.
  - II. The variance of the set of sample means varies directly as the size of the samples and inversely as the variance of the original population.
  - III. The standard deviation of the set of sample means varies directly as the standard deviation of the original population and inversely as the square root of the size of the samples.
- (a) I only
  - (b) II only
  - (c) III only
  - (d) I and II
  - (e) I and III
5. The average number of daily emergency room admissions at a hospital is 85 with a standard deviation of 37. In an SRS of 30 days, what is the probability that the mean number of daily emergency admissions is between 75 and 95?
- (a) .1388
  - (b) .2128
  - (c) .8612
  - (d) .8990
  - (e) .9970
6. A factory produces plate glass with a mean thickness of 4 mm and a standard deviation of 1.1 mm. A simple random sample of 100 sheets of glass is to be measured, and the mean thickness of the 100 sheets is to be computed. What is the probability that the average thickness of the 100 sheets is less than 4.1 mm?
- (a) 0.8186
  - (b) 0.3183
  - (c) 0.1814
  - (d) 0.6817
  - (e) 0.5000
7. A news magazine claims that 30% of all New York City police officers are overweight. Indignant at this claim, the New York City police commissioner conducts a survey in which a random sample of 200 New York City police officers are weighed. Fifty-two, or 26%, of the surveyed officers turn out to be overweight. Which of the following statements about this situation is strictly *false*?
- (a) The number "26%" is a parameter.
  - (b) The number "30%" is a parameter.
  - (c) The number "26%" is a statistic.
  - (d) None of (a), (b), or (c).
  - (e) All of (a), (b), or (c).

8. If a statistic used to estimate a parameter is such that the mean of its sampling distribution is equal to the true value of the parameter being estimated, the statistic is said to be:
- (a) random
  - (b) biased
  - (c) a proportion
  - (d) unbiased
  - (e) precise
9. The central limit theorem says that when a simple random sample of size  $n$ , where  $n$  is sufficiently large, is drawn from any population with mean  $\mu$  and standard deviation  $\sigma$ , which of the following is true?
- (a) The standard deviation of the sample means is  $\frac{\sigma}{\sqrt{n}}$ .
  - (b) The distribution of the population is exactly normal.
  - (c) The distribution of the sample means is approximately normal.
  - (d) The mean of the sample means is  $\mu$ .
  - (e) The distribution of the sample standard deviations is approximately normal.

### Free Response

1. The scores of students on the ACT exam in a recent year had a normal distribution with  $\mu = 20.4$  and  $\sigma = 5.8$ .

- (a) What is the probability that a randomly chosen student scored 24 or higher on the ACT?

$$P(X \geq 24) = P\left(Z \geq \frac{24 - 20.4}{5.8}\right) = P(Z \geq .6207) \quad \text{normalcdf}(.6207, 1e99) = .2674$$

- (b) What is the mean and standard deviation of the average ACT score ( $\bar{X}$ ) for an SRS of 30 students.

$$\mu_{\bar{x}} = 20.4 \quad \sigma_{\bar{x}} = \frac{5.8}{\sqrt{30}} = 1.059$$

- (c) What is the probability that the average ACT score of an SRS of 30 students is 24 or higher?

$$P(\bar{x} \geq 24) = P\left(Z \geq \frac{24 - 20.4}{1.059}\right) = P(Z \geq 3.3997) \quad \text{normalcdf}(3.3997, 1e99) = .0003374$$

- (d) Would your answers to a, b or c be affected if the distribution of ACT scores in the population were distinctly non-normal?

The answers to "b" and "c" would not be affected because the Central Limit Theorem applies. The answer to "a" would be affected because we aren't working in a sampling distribution.

2. Consider the sampling distribution of a sample mean obtained by random sampling from an infinite population. This population has a distribution that is highly skewed toward the larger values.

(a) How is the mean of the sampling distribution related to the mean of the population?

The means of the two populations are the same.

(b) How is the standard deviation of the sampling distribution related to the standard deviation of the population?

$\sigma_{\bar{x}}$  will be the same as  $\sigma$  when  $n = 1$ , but it will become less spread as  $n$  moves farther away from 1.

(c) How is the shape of the sampling distribution affected by the sample size?

The sampling distribution approaches normal as the sample size increases.

3. The amount of sugar used in a gallon of high-quality southern sweet tea is approximately normally distributed with a mean of 1.8 cups with a standard deviation 0.4 cups.

(a) What is the probability that a randomly selected gallon of tea will have at least 2.3 cups of sugar in it?

$$P(X \geq 2.3) = P\left(Z \geq \frac{2.3 - 1.8}{0.4}\right) = P(Z \geq 1.25) \quad \text{normalcdf}(1.25, 1e99) = .1056$$

(b) What is the probability that the total amount of sugar in ten gallons of tea will be at least 23 cups?

$$P(\bar{x} \geq 2.3) = P\left(Z \geq \frac{2.3 - 1.8}{.4/\sqrt{10}}\right) = P(Z \geq 3.95) \quad \text{normalcdf}(3.25, 1e99) = .0000386$$

Also do 9.45, 9.49, 9.53