Sampling Distributions

6.1   Minimum Variance Unbiased Point Estimators

To complete this section of homework watch Chapter Six, Lecture Examples: 92.5 and 93.

1. If A is used as an estimate of α and $E(A) = \alpha - 3$, is A a biased estimator of α or unbiased? If it is biased what is the bias?

2. If B is used as an estimate of β and $E(B) = \beta$, is B a biased estimator of β or unbiased? If it is biased what is the bias?

3. If d is used as an estimate of δ and $E(d) = \delta + 15$, is d a biased estimator of δ or unbiased? If it is biased what is the bias? VS

4. True or False: Values of an unbiased estimator tend to cluster around the target parameter. VS

5. True or False: If an estimator is unbiased, it means that the average value of the estimator is the same as the target parameter. VS

6. Estimators A and B are used to estimate parameter θ. If both estimators are unbiased, but estimator A has variance 126 in^2 and estimator B has variance 100 in^2, which estimator is the better choice? VS

7. Estimators C and D are used to estimate parameter λ. If estimator C is unbiased with variance 25 m^2, and estimator D is biased with variance 4 m^2, which estimator is the better choice?

[Need more exercises?](#)

6.1   Answers:

1. Biased, -3
2.   Unbiased
3.   Biased, 15
4.   True
5.   True
6.   B
7.   C

📹: *indicates the exercise has a video devoted to it in the corresponding section of STATSprofessor.com*

6.2   Using the Central Limit Theorem

To complete this section of homework watch Chapter Six, Lecture Examples: 95, 96, and 97.

8. For women, heights are normally distributed with a mean of 63.6 and a standard deviation of 2.5. If samples of 49 women are selected at random from the population, would the average heights found for each sample be as varied as the individual measurements taken for each woman? VS

9. Statistics I exam grades on the final exam are normally distributed with a mean of 75 and a standard deviation of 13. If samples of 100 students are selected at random from the population, would the average grade found for each class of 100 students be as varied as the individual grades for each student? VS

10. For women, heights are normally distributed with a mean of 63.6 and a standard deviation of 2.5. If samples of 49 women are selected at random from the population, what is the mean of the sample means? What is the standard error (standard deviation) of the sample means?

11. Statistics I exam grades on the final exam are normally distributed with a mean of 75 and a standard deviation of 13. If samples of 100 students are selected at random from the population, what is the mean of the sample means? What is the standard error (standard deviation) of the sample means?

12. A car manufacturer makes a certain transmission gear with a mean circumference of 11 mm. This is the size that allows the gear to fit precisely into the transmission to avoid unnecessary wear and tear on the transmission's other moving parts. The manufacturing process is not perfect, so there is some variation in the circumference of the gear. The circumference measurements are normally distributed, and the standard deviation of the gear's circumference is 0.05mm.
    a. Find the probability that a randomly selected gear produced by this company has a circumference less than 10.9 mm.
    b. Find the probability that 22 randomly selected gears produced by this company have a mean circumference less than 10.9 mm.

13. A recent trial conducted in the Department of Kinesiology and Nutrition at the University of Illinois at Chicago investigated the consequences of alternate day fasting (ADF) in a group of obese men and women. The study design was quite complex and involved three dietary phases: the first part was a 2-week baseline period that established the typical diet of the participants; the second portion of the study involved the use of a carefully controlled diet which yielded 75% fewer calories on alternate days for 4 weeks; the final phase allowed the volunteers to select their own food while still maintaining a 75% calorie deficit every other day. After 8 weeks of treatment, participants had an average 12.5 lbs reduction in body weight with a standard deviation of 3.6 pounds (note: lean body mass of the participants remained relatively constant). Assuming the amount of weight loss has a normal distribution.

   a. Find the probability that the weight loss for a randomly selected dieter on this plan is between 7 and 9 pounds.
   b. Find the probability that the average weight loss for a randomly selected group of 16 dieters on this plan is between 7 and 9 pounds.

14. Among women aged 15 to 44, average age at first sexual intercourse was 17.3 years. Their male counterparts lost their virginity at 17.0 years on average; both groups had a standard deviation of 2.17 years. What is the probability that a randomly chosen group of 36 females lost their virginity at an age under 16.2 years old? 📹 VS

15. The average age at first marriage is 25 for women and 27.8 for men in the US. If the standard deviation for women is four years, what is the probability that a random selection of 32 women have an average age at first marriage between 26 and 27? 📹 VS

16. The average salary for a psychology Ph.D. graduate specializing in clinical, counseling, or school psychology is $64,140 with a standard deviation of $18,405. Find the probability that a group of 31 randomly selected psychologists has an average salary higher than $74,000 per year. 📹 VS

17. The average time to complete my second exam in stats II is 95.82 minutes with a standard deviation of 14 minutes. Find the probability that a class of 60 students has an average completion time of more than 100 minutes. 📹 VS

18. The average time to graduate from Oregon State University with a bachelor's degree in 2008 was 4.68 years. If the standard deviation is 1.5 years, find the probability that a random sample of 40 graduates from Oregon State finished between four and five years. 📹 VS

19. Body fat percentages: The average guy in his 20's (ages 20 – 29) has a body fat percentage of 15.75%. The standard deviation for this group is 0.99%. Find the probability that a randomly chosen group of 39 males in their 20's has an average body fat percentage below 14%.

20. The average American watches four hours of TV per day with a standard deviation of 1.3 hours. Find the probability that 49 randomly selected people in the US watch an average of 3.5 hours of TV or less per day.

21. The BLS (Bureau of Labor Statistics) conducted a survey of people to study how we spend our time. It was revealed that people 20 – 24 years old read an average of 0.12 hours per day with a standard deviation of 0.33 hours per day. What is the probability that a group of 36 randomly chosen 20 – 24 year olds reads an average of 0.25 hours or more per day?

6.2   Answers:

8.   Average heights would be less varied.

9.   Class averages would be less varied.

10. 63.6, 2.5/7 = .357

11. 75, 1.3

12. A. 0.0228, B. 0

13. A. 0.103, B. 0.0001

14. 0.0012

15. 0.077

16. 0.0014

17. 0.0104

18. 0.91

19. 0

20. 0.0036

21. 0.0091

Need more exercises?   Take a sample exam for chapter 5 & 6

Chapter 6 Mixed Review

22. The hourly wages for English professors are normally distributed with a mean of $32.50 and a standard deviation of $7.25. If samples of 49 English professors are selected at random from the

population, would the average hourly wage found for each sample be more or less varied than the individual hourly wages for each English professor?

23. Several FIU students choose to live off campus. The mean of these commute distances is 5.4 miles, and the standard deviation is 2.3 miles. Find the standard error of the mean (the standard deviation of the sample means) for the sampling distribution when taking random samples of size 14 from the population.

24. Which point estimator is the best choice for use as an estimator of λ ?
    Estimator A with an expected value of λ and a variance of 3.8.
    Estimator B with an expected value of λ and a variance of 1.2.
    Estimator C with an expected value of $\lambda - 2$ and a variance of 0.4.

25. The hourly wages for English professors are normally distributed with a mean of $32.50 and a standard deviation of $7.25. Find the mean of the sample means for the sampling distribution that results from taking random samples of size 16 from the population.

26. The length of time for students to complete this set of exercises is normally distributed with a mean of 20 minutes and a standard deviation of 5.9 minutes. Find the probability that a random sample of 10 students takes less than 15 minutes to complete the set of exercises.

Chapter 6 Mixed Review Answers

22. The averages would be less varied.

23. $2.3 / \sqrt{14} \approx 0.6147$

24. Estimator B because it is unbiased and has a smaller variance than estimator A.

25. $32.50

26. 0.0037