

7.1 The Central Limit Theorem for Sample Means

Section 7.1 The Central Limit Theorem for Sample Means

Learning Objective:

In this section, you will:

- Understand and apply the normal probability distribution to real-world situations
- Given an area/percentage/probability, calculate the z-score (or cutoff score) that corresponds to that amount
- Given a range of values on a normal distribution, calculate the probability.
- Solve similar problems using the Central Limit Theorem, when appropriate

Central Limit Theorem

The central limit theorem for sample means says that if you keep drawing larger and larger samples and calculating their means, the sample means form their own normal distribution. The normal distribution has the same mean as the original distribution and a variance that equals the original variance divided by the sample size.

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- $\mu_x = \mu$
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Example 1: An unknown distribution has a mean of 90 and a standard deviation of 15. Samples of size $n = 25$ are drawn randomly from the population.

1. In words, $\bar{X} =$
2. In words, $\bar{X} =$
3. $\bar{X} \sim$
4. Find the probability that the sample mean is between 85 and 92.
5. Find the value that is two standard deviations above the expected value, 90, of the sample mean.

Example 2: The length of time, in hours, it takes an "over 40" group of people to play one soccer match is normally distributed with a mean of two hours and a standard deviation of 0.5 hours. A sample of size $n = 50$ is drawn randomly from the population. 1. In words, $\bar{X} =$

2. In words, $\bar{X} =$
3. $\bar{X} \sim$
4. Find the probability that the sample mean is between 1.8 hours and 2.3 hours.
5. Find the 95th percentile for the sample mean hours (to one decimal place).

Example 3: The lengths of pregnancies are normally distributed with a mean of 268 days and a standard deviation of 15 days.

1. If one pregnant woman is randomly selected, find the probability that her length of pregnancy is less than 260 days. Is a length of 260 days significantly low for a pregnancy?
2. 25 women were selected to go on a special diet just before they became pregnant. Find the probability that 25 randomly selected women have a mean pregnancy length that is less than 260 days.

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For more information and examples see online textbook OpenStax Introductory Statistics pages 400-405.

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