

I am going to give you a prompt from a problem set, and then I will ask you question that have a true or false answer, I want you to tell me why any answer is false if it is. Here is the prompt: A hospital administrator hoping to improve wait times decides to estimate the average emergency room waiting time at her hospital. He collects a simple random sample of 64 patients and determines the time (in minutes) between when they checked in to the ER until they were first seen by a doctor. A 95% confidence interval based on this sample is (128 minutes, 147 minutes), which is based on the normal model for the mean. Determine whether the following statements are true or false, and explain your reasoning for those statements you identify as false.

✓ Searching for: **confidence interval definition**

✓ Generating answers for you...

OK, I will try to help you with this problem. A confidence interval is a range of values that describes the uncertainty surrounding an estimate ¹. It means that if you repeat the same sampling procedure many times, you would expect the true population mean to fall within this range for a certain percentage of times ² ³. The level of confidence is usually expressed as a percentage, such as 95% or 99%. The higher the confidence level, the wider the interval will be.

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First question is: This confidence interval is not valid since we do not know if the population distribution of the ER wait times is nearly normal.

✓ Searching for: **normal model for the mean**

✓ Generating answers for you...

This statement is **false**. The confidence interval based on the normal model for the mean does not require that the population distribution of the ER wait times is nearly normal. It only requires that the sample size is large enough (usually at least 30) to invoke the central limit theorem, which states that the sampling distribution of the sample mean will be approximately normal regardless of the shape of the population distribution ¹. Since the sample size in this problem is 64, which is larger than 30, we can use the normal model for the mean to construct a valid confidence interval.

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second question is: We are 95% confident that the average waiting time of these 64 emergency room patients is between 128 and 147 minutes.

This statement is **false**. The confidence interval does not tell us anything about the average waiting time of these 64 emergency room patients. We already know their average waiting time from the sample mean. The confidence interval tells us something about the average waiting time of **all** emergency room patients in the population. We are 95% confident that the true population mean is between 128 and 147 minutes, not the sample mean.

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Third question: We are 95% confident that the average waiting time of all patients at this hospital's emergency room is between 128 and 147 minutes.

This statement is **true**. This is the correct interpretation of the confidence interval. It means that if we repeated this sampling procedure many times, we would expect 95% of the confidence intervals to contain the true population mean. It does not mean that 95% of the population values are in this interval, or that there is a 95% chance that the population mean is in this interval.

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Next question: A 99% confidence interval would be narrower than 95% confidence interval since we need to be more sure of our estimate.

This statement is **false**. A 99% confidence interval would be wider than a 95% confidence interval since we need to capture more possible values of the population mean to be more confident. A higher confidence level means a larger margin of error, which increases the width of the interval. A lower confidence level means a smaller margin of error, which decreases the width of the interval.

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Next: The margin of error is 9.5 and the sample mean is 137.5.

This statement is **true**. The margin of error is half the width of the confidence interval. The width of the confidence interval is $147 - 128 = 19$. The margin of error is $19 / 2 = 9.5$. The sample mean is the midpoint of the confidence interval. The midpoint of the confidence interval is $(147 + 128) / 2 = 137.5$.

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In order to decrease the margin of error of a 95% confidence interval to half of what it is now, we would need to double the sample size.

This statement is **false**. In order to decrease the margin of error of a 95% confidence interval to half of what it is now, we would need to quadruple the sample size. The margin of error is proportional to the inverse square root of the sample size. That means if we want to reduce the margin of error by a factor of 2, we need to increase the sample size by a factor of 4. For example, if the current sample size is 64 and the margin of error is 9.5, then we would need a sample size of 256 and a margin of error of 4.75 to achieve the same level of confidence.

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Tell me if I asked you this question before: 95% of such random samples would have a sample mean between 128 and 147 minutes.

You have not asked me this question before. This statement is **false**. 95% of such random samples would have a **confidence interval** that contains the population mean between 128 and 147 minutes. The sample mean is a single value that varies from sample to sample. The confidence interval is a range of values that describes the uncertainty around the sample mean. The confidence level tells us how often the confidence interval would capture the population mean if we repeated the sampling procedure many times.