

For each problem, circle TRUE or FALSE. If the answer is FALSE, either explain why it is false or make a small change to make the statement true.

Problem 1: TRUE or FALSE:

A 95% confidence interval for μ will be wider than a 99% confidence interval for μ when based on the same data.

Solution: False. You need a wider interval to increase confidence. The middle 99% of a t distribution is wider than the middle 95%.

Problem 2: TRUE or FALSE:

A 95% confidence interval for the mean number of children of 40-year-old American women cannot be (1.7, 1.9) because the number of children each woman has is a whole number.

Solution: False. Even if all the individual observations are integers, the mean (population or sample) can be a noninteger.

Problem 3: TRUE or FALSE:

If the interval (0.2, 2.2) is a 95% confidence interval for a difference in population means $\mu_1 - \mu_2$, then the nondirectional (two-sided) hypothesis test with null hypothesis $\mu_1 = \mu_2$ would have a p-value smaller than 0.05.

Solution: True. A 95% confidence interval will be completely below 0 if and only if the t test statistic is in the left 2.5% tail. A 95% confidence interval will be completely above 0 if and only if the t test statistic is in the right 2.5% tail. This corresponds exactly to the case when the p-value is less than 0.05.

Problem 4: TRUE or FALSE:

A p-value is the probability of observing a new test statistic at least as extreme as that actually observed assuming the alternative hypothesis is true.

Solution: False. P-values are calculated assuming the null hypothesis is true.

Problem 5: TRUE or FALSE:

A p-value of 0.02 means that there is only a two percent chance that the null hypothesis is correct.

Solution: False, false, false! P-values are *not* the probabilities of null hypotheses. A p-value of 0.02 means that if the null hypothesis were true and a new data set were collected, there would be a probability of 0.02 of obtaining a test statistic at least as extreme (in favor of the alternative hypothesis) as that actually obtained.

Problem 6: TRUE or FALSE:

If a hypothesis test is significant at the 5% level, it is also significant at the 1% level.

Solution: False. If a test is significant at the 5% level, the p-value is less than 5%. It may or may not also be less than 1%. (However, if it is significant at the 1% level it must be significant at the 5% level.)

Problem 7: TRUE or FALSE:

A 95% confidence interval for the mean number of upsets in the first round of the men's NCAA basketball tournament is 7.8 ± 1.3 . In the future, we expect 95% of all similar tournaments to have 7, 8, or 9 first round upsets.

Solution: False. Confidence intervals are statements about the likely location of *parameters*. The proportion of tournaments with 7, 8, or 9 first round upsets is a measure of the location of *individuals in a population*. As the sample size increases, the confidence interval for a parameter gets more narrow, but the proportion of individuals in the population in a given range remains unchanged. (This was the hardest question on the exam.)

Problem 8: TRUE or FALSE:

Causal relationships cannot be determined from observational studies.

Solution: False. It is very difficult to infer causal relationships from observational studies, but it can be done. Think of the inference that smoking causes lung cancer in humans. It might take very large studies to examine all of the plausible confounding factors and rule them all out.

Problem 9: TRUE or FALSE:

Randomization completely removes biases from all factors, whether the investigator knows about them or not.

Solution: I accepted either answer. It is true that with randomization *on the average*, every factor, known or unknown, will be balanced for any comparison. However, it is false that complete balance will be achieved for every possible randomization. Rather, for any particular single randomization, the effects of some factors may not be balanced. Large samples are necessary to make the probability of a highly unbalanced randomization unlikely.

Problem 10: TRUE or FALSE:

In an observational study on birthweights, women who smoke during pregnancy also consume more alcohol during pregnancy. The effects of maternal smoking and drinking on birthweight are said to be **confounded**.

Solution: True.