Hypothesis testing - Problems

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- We are in section 9.5 of the textbook
- This chapter is about *hypothesis testing*. This is the other side of estimation.
- **General process for hypothesis testing:**
  1. We identify the hypothesis we want to test. We state a **null hypothesis** H_0 that says two values are equal. The alternative hypothesis H_1 says the values are different, using $<$, $>$, or $\neq$.
  2. We identify the **level of significance** that we want to use.
  3. We convert the value we are testing (usually a sample statistic) into a z-value in the appropriate sampling distribution.
  4. We compute the probability (**P value**) of getting a sample *as extreme or more extreme* than the sample we are interested in.
  5. If this probability is lower than the limit we set in step (2), we say that we can **reject** the null hypothesis and **accept** the alternative hypothesis. Otherwise, we say the evidence is not strong enough to reject the null hypothesis.
- When the alternative hypothesis uses $<$ or $>$, we use a one-tailed probability from the normal table. When the alternative hypothesis uses $\neq$, we use a two-tailed probability.

1. We have a population with mean 200 and standard deviation 40. The population distribution is normal. We sample 25 members of a subpopulation, and the sample average is 185. We hypothesize the average for the whole subpopulation is less than 200.

   (a) What are the null hypothesis and the alternative hypothesis

   (b) What is the probability that a random sample would have an average less than or equal to the sample average we obtained? You can use the formula

   $$z = (\bar{x} - \mu) / \left(\frac{\sigma}{\sqrt{n}} \right)$$

   to find the z-value, and a normal table to find the probability.

   (c) What conclusion can we make about the null hypothesis?

2. We have a population with mean 55 and standard deviation 3. The population distribution is normal. We sample 50 members of a subpopulation, and the sample average is 56.3. We hypothesize the average for the whole subpopulation is greater than 55.

   (a) What are the null hypothesis and the alternative hypothesis

   (b) What is the probability that a random sample would have an average less than or equal to the sample average we obtained? You can use the formula

   $$z = (\bar{x} - \mu) / \left(\frac{\sigma}{\sqrt{n}} \right)$$

   to find the z-value, and a normal table to find the probability.

   (c) What conclusion can we make about the null hypothesis?

3. We have a population with mean 120 and standard deviation 30. The population distribution is normal. We sample 100 members of a subpopulation, and the sample average is 125.

   We hypothesize the average for the whole subpopulation is not equal to 120. This means our null hypothesis is:
   $$H_0 : \bar{x} = 120$$
   and the alternative hypothesis is
   $$H_1 : \bar{x} \neq 120.$$
   We will need to use a **two tailed** probability to test these hypotheses.

   (a) Use the formula
   $$z = (\bar{x} - \mu)/\left(\frac{\sigma}{\sqrt{n}}\right)$$
   to find the z-value

   (b) Find the one-tailed probability for that z-value. Then multiply it by 2 to get the two-tailed probability.

   (c) What conclusion can we make about the null hypothesis? Use a 1% level of significance.