Statistics can help decide the authorship of literary works. Sonnets by an Elizabethan poet are known to contain an average of \( \mu = 6.9 \) new words (words not used in the poet’s other works). The standard deviation of the number of new words is \( \sigma = 2.7 \). Now a manuscript with five new sonnets has come to light, and scholars are debating whether it is the poet’s work. The new sonnets contain an average of \( \bar{x} = 9.2 \) words not used in the poet’s known works. We expect poems by another author to contain more new words.

a. State appropriate hypotheses in both words and symbols.

\[ H_0: \mu = 6.9 \quad H_A: \mu > 6.9 \]

b. Identify the appropriate statistical procedure and verify conditions for its use.

1-sided 1-sample \( z \)-test.

SRS.

\( \sigma \) is known.

c. Calculate the test statistic and the \( P \)-value. Illustrate using the graph provided.

\[ z = \frac{9.2 - 6.9}{\frac{2.7}{\sqrt{5}}} = 1.90 \]

\( p \)-value: 0.0284

d. State your conclusions clearly in complete sentences.

Reject \( H_0 \) since our \( p \)-value of 0.0284 is much smaller than 0.05. There is strong evidence to suggest that mean number of words is greater than 6.9.
In the past, the mean score of the seniors at South High on the American College Testing (ACT) college entrance examination has been 20. This year a special preparation course is offered, and all 53 seniors planning to take the ACT test enroll in the course. The mean of their 53 ACT scores is 22.1. The principal believes that the new course has improved the students’ ACT scores. Assume that ACT scores vary normally with standard deviation 6.

a. State hypotheses in both words and symbols for testing the principal’s claim.

\[ H_0: \mu = 20 \quad H_A: \mu > 20 \]

b. Identify the appropriate statistical procedure and verify conditions for its use.

1-sided 1-sample Z-test.

SRS.

\( \sigma \) known, normal scores.

c. Calculate the test statistic and the \( P \)-value. Illustrate using the graph provided.

\[
Z = \frac{22.1 - 20}{\frac{6}{\sqrt{53}}} = 2.55
\]

\( P \)-value: 0.0054

d. State your conclusions clearly in complete sentences.

Reject \( H_0 \) since the \( P \)-value of 0.0054 is so small. There is strong evidence to suggest that the mean ACT score is greater than 20. There is strong evidence to suggest that the prep course is helping.
An agricultural field trial compares the yield of two varieties of tomato for commercial use. The researchers divide in half each of 10 small plots of land in different locations and plant each tomato variety on one half of each plot. After harvest, they compare the yields in pounds per plant at each location. The 10 differences (Variety A – Variety B) give \( \bar{x} = 0.34 \). Assume a population standard deviation of \( \sigma = 0.83 \). We want to determine if there is a difference in the mean yields, so our null hypothesis is that there is no difference in the mean yields, i.e., \( H_0: \mu = 0 \). \( H_a: \mu \neq 0 \). We asked, “Is there convincing evidence at the 5% significance level that the mean yield of tomatoes is different from \( \mu = 0 \)” A significance test to answer this question was carried out. The test statistic is \( z = 1.2954 \), and the \( P \)-value is 0.1952.

a. Describe what a Type I error would be in this situation.

\[ \text{To believe that there is a difference between Varieties A&B when there isn't.} \]

b. Describe what a Type II error would be in this situation.

\[ \text{To believe that there is no difference between Varieties A&B when there actually is.} \]

c. What type of error is more serious in this case? Justify your answer.

\[ \text{Type II - Variety A or B would be more effective yet we would not know this info.} \]

d. Was this a one-sided or two-sided significance test? How do you know?

\[ \text{Two sided test since } H_a: \mu \neq 0. \]
Read the brief newspaper article on using a depression pill to help smokers quit.

**Depression Pill Seems to Help Smokers Quit**

BOSTON — Taking an antidepression medicine appears to double smokers’ chances of kicking the habit, a study found. The Food and Drug Administration approved the marketing of this medicine, called Zyban or bupropion, to help smokers in May. The results of several studies with the drug, including one published in today’s issue of the *New England Journal of Medicine*, were made public then.

The newly published study was conducted on 615 volunteers who wanted to give up smoking and were not outwardly depressed. They took either Zyban or dummy pills for 6 weeks. A year later, 23 percent of those getting Zyban were still off cigarettes, compared with 12 percent in the comparison group.

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a. The results of this experiment were significant at the $\alpha = .05$ significance level. In your opinion, are the results practically significant? Justify your position.

* Zyban still has a 77% failure rate.
* This is not significant to people trying to quit smoking.

b. In performing a test of significance, the researcher can choose between adopting a fixed significance level or calculating a *P*-value. Does it matter which approach is taken? If so, describe the circumstances when one should use each approach.

* Significance level is good for making a decision, e.g., in court cases evidence.
  * Food production
  * Production lines

* *P*-value is used to assess strength of evidence against null hypothesis.
  * Used in drug testing
  * Advertising effectiveness
  * Political polls.