

Chapter 13 Large Sample Hypothesis Testing

I. Introduction

- A. Chapter 13 explores a systematic method for testing claims about the population mean using a sample mean.
- B. Large sample ($n \geq 30$) tests using z will be considered. The standard deviation (σ) may be known or unknown.
- C. Small sample ($n < 30$) t distribution tests used by most statistics software will be explored in chapter 16.
- D. Issues to be tested include
 1. Quality control issues such as the weight of a computer part
 2. Marketing research issues such as the proportion of consumers liking a new product
 3. Political issues such as the proportion of voters planning to vote for a political candidate

II. Definitions

- A. **The null hypothesis (H_0)** states some hypothesized value for a (population) parameter such as the mean.
 1. Read "H sub-zero," its acceptance implies **no statistical difference** between a parameter (μ) and a statistic (\bar{x}).
 2. Linda Smith wants to know whether the average customer purchase has decreased from last year's mean of \$7.75 because a recent sample of 49 had a mean of only \$7.50 (see page 67).
 - a. A null hypothesis might read "the average purchase has not decreased from \$7.75."
 - b. In effect, $H_0 : \mu \geq \$7.75$

3. The direction of the inequality is greater than or equal to because this implies the mean has not decreased.
4. H_0 is rejected if the measured difference between the hypothesized μ and \bar{x} is large and seldom happens.

- B. **The alternate "research" hypothesis (H_1)** represents the possible difference being studied.

1. Read "H sub-one," it implies **there is a statistical difference**. It is the complement of the null hypothesis. $H_1 : \mu < \$7.75$
2. An alternate hypothesis might read "the mean purchase is under \$7.75."

C. Level of significance

1. Rejection of a true null hypothesis should rarely happen.
 - a. The level of significance states the maximum probability of such an error.
 - b. A .01 significance level indicates a sample statistic at least this different from some hypothesized parameter will happen no more than 1% of the time. Therefore, the maximum error is one percent.
 - c. The significance level provides a limit for the sample statistic. Beyond this limit, H_0 is rejected.
 - d. The cost associated with making an incorrect decision determines the appropriate level of significance.

2. Type I or alpha error (α)

- a. Alpha error equals the level of significance. It measures the risk of rejecting a true null hypothesis.
- b. Deciding to reject the null hypothesis about the average purchase of \$7.75 creates the possibility of type I error (accepting a decrease when there is not a decrease).
- c. Traditional alpha errors include .05 for marketing research questions and .01 for quality control questions.

3. **Type II or beta error (β)**, accepting a false null hypothesis, is examined on page 89.

D. Test statistics and their critical values

1. Test statistics are used to determine the validity of a null hypothesis. Examples include \bar{x} and \bar{p} .
2. Here, \bar{x} will be used to test a null hypothesis concerning population mean purchases described above.
3. **We begin by assuming the null hypothesis is true.** For the .01 level of significance, a sample mean that separates 1% of the sampling distribution's sample means from the other 99% will be the critical value.
4. When testing a null hypothesis related to a normal sampling distribution, the test statistic is often converted into its z value. This z value is like the **critical value** because it separates the region of acceptance from the region of rejection.
5. Here we have a critical value for z of -2.33 for the .01 level of significance as $.49 \rightarrow z = -2.33$. This means $\leq 1\%$ of the sample means are beyond -2.33 standard deviations from μ and result in the error of rejecting a true null hypothesis.
6. The alternate hypothesis points toward the region of rejection. In this **one-tail problem**, with an H_1 of $\mu < \$7.75$, the critical area is to the left because Linda is concerned that a low sample mean of \$7.50 indicates the population mean has decreased.

Error Summary		
Decision	Nature's True State	
	H_0 is true	H_0 is false
Accept H_0	Correct	Type II error
Reject H_0	Type I error	Correct

