AP Statistics
Mr. Murphy
10.3 Single Sample Hypothesis Tests for a Population Mean

HW Pg. 537 #10.43, 10.44, 10.46, 10.49, 10.62

Goals: 1. Conduct a test of significance for a population mean.

Let's say we are interested in testing a hypothesis of the form

$$H_0 : \mu = \text{hypothesized value}$$

Depending on whether σ is known or unknown, we will use either the z or the t test statistic.

Case 1: σ is known

Test statistic: $z = \dfrac{\bar{x} - \text{hypothesized value}}{\sigma / \sqrt{n}}$

P – value: Computed as area under the z curve

Case 2: σ is unknown (s is known)

Test statistic: $t = \dfrac{\bar{x} - \text{hypothesized value}}{s / \sqrt{n}}$

■ One-Sample *t* Test for a Population Mean

Null hypothesis: H_0: μ = hypothesized value.

Test statistic: $t = \dfrac{\bar{x} - \text{hypothesized value}}{\frac{s}{\sqrt{n}}}$

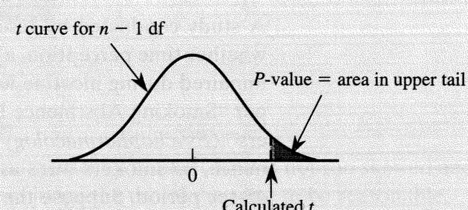
Alternative Hypothesis:	***P*-Value:**
H_a: $\mu >$ hypothesized value	Area to right of calculated t under t curve with df = $n - 1$
H_a: $\mu <$ hypothesized value	Area to the left of calculated t under t curve with df = $n - 1$
H_a: $\mu \neq$ hypothesized value	(1) 2(area to right of t) if t is positive, or (2) 2(area to left of t) if t is negative

Assumptions:
1. $\bar{x}$ and s are the sample mean and sample standard deviation, respectively, from a *random sample.*
2. The *sample size is large* (generally $n \geq 30$) or *the population distribution is at least approximately normal.*

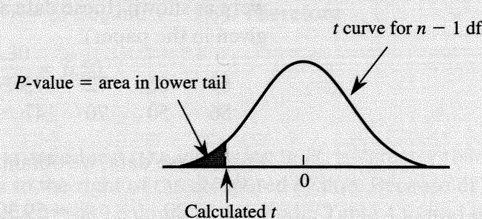
P – value: Computed as area under the t curve with $df = n - 1$.

■ Finding *P*-Values for a *t* Test

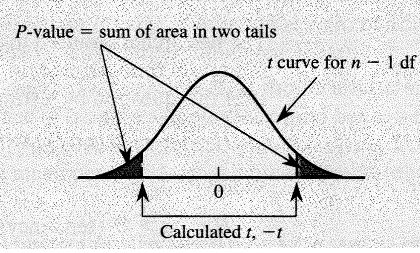
1. **Upper-tailed test:**
   H_a: $\mu >$ hypothesized value.
   P-value computed as illustrated:



2. **Lower-tailed test:**
   H_a: $\mu <$ hypothesized value.
   P-value computed as illustrated:



3. **Two-tailed test:**
   H_a: $\mu \neq$ hypothesized value.
   P-value computed as illustrated:



Ex1 One concern employers have about the use of technology is the amount of time that employees spend each day making personal use of company technology, such as personal phone calls, non-business related e-mail, Internet use, and computer games. The AP reported that a management consultant believes that, on average, workers spend 75 minutes a day making personal use of company technology. Suppose that the CEO of a large corporation wants to determine whether the average amount of time spent on personal use of company technology for her employees is greater than the reported value of 75 min. Each person in a random sample of 10 employees was contacted and asked about daily personal use of company technology. The resulting data are as follows:

66 70 75 88 69 89 71 63 86 71

Do these data provide evidence that the mean for this company is greater than 75 min.? Carry out a hypothesis test with $\alpha = 0.05$.

Ex2 An article reported that female crickets are attracted to males that have high chirp rates and hypothesized that chirp rate is related to nutritional status. The usual chirp rate for male field crickets was reported to vary around a mean of 60 chirps per second. To investigate whether chirp rate was related to nutritional status, investigators fed male crickets a high protein diet for 8 days, after which chirp rate was measured. The mean chirp rate for the crickets on the high protein diet was reported to be 109 chirps per second. Is this convincing evidence that the mean chirp rate for crickets on a high protein diet is greater than 60 (which would then imply an advantage in attracting the ladies)? Suppose that the sample size and sample standard deviation are n = 32 and s = 40. We test the relevant hypotheses with $\alpha = 0.01$.

Checkpoint
Multiple Choice

1. A pharmaceutical company claims that a medication will produce a desired effect for a mean time of 58.4 minutes. A government researcher runs a hypothesis test of 250 patients and calculates a mean of $\bar{x} = 59.5$, with a standard deviation of $s = 8.3$. In which of the following intervals is the P - value located?

(a) $P < 0.01$ (b) $0.01 < P < 0.025$ (c) $0.025 < P < 0.05$

(d) $0.05 < P < 0.10$ (e) $P > 0.10$

2. An automotive company executive claims that a mean of 48.3 cars per dealership are being sold each month. A major stockholder believes this claim is high and runs a test by sampling 30 dealerships. What conclusion is reached if the sample mean is 45.4 cars with a standard deviation of 15.4?

(a) There is sufficient evidence to support the executive's claim.
(b) There is sufficient evidence to refute the executive's claim.
(c) The stockholder has sufficient evidence to reject the executive's claim.
(d) The stockholder does not have sufficient evidence to reject the executive's claim.
(e) There is not sufficient data to reach any conclusion.

3. The Acme Whoopee Cushion Company claims that each of its unbreakable whoopee cushions consists of 18 oz. of rubber. As a quality control engineer you want to know if the population mean is consistent with the claim of 18 oz. Which of the following would be appropriate for testing the company's claim?

I. A significance test with a one-sided alternative hypothesis
II. A significance test with a two-sided alternative hypothesis
III. A confidence interval

(a) I only (b) II only (c) III only (d) I and III (e) II and III

4. Given a hypothesized population mean $\mu = 58.4$, a set of sample data (with all three assumptions met) gives a p-value of 0.0154 if the alternate hypothesis is $\mu < 58.4$. Which of these statements is true about our hypothesis test if we use a significance level $\alpha = 0.02$?

I We reject the null hypothesis if the alternate hypothesis is $\mu < 58.4$
II We fail to reject the null hypothesis if the alternate hypothesis is $\mu \neq 58.4$
III We reject the null hypothesis if the alternate hypothesis is $\mu > 58.4$

(a) I only
(b) I and II .
(c) I and III.
(d) II and III
(e) III only