

AP Statistics

Chapter 9: Testing a Claim: Significance Test

Day 3

HW: Lesson 3 Practice Worksheet

1. Bottles of a popular cola are supposed to contain 300 milliliters (ml) of cola. There is some variation from bottle to bottle because the filling machinery is not perfectly precise. From experience, the distribution of the contents is approximately Normal. An inspector measures the contents of six randomly selected bottles from a single day's production. The results are

299.4 297.7 301.0 298.9 300.2 297.0

Do these data provide convincing evidence that the mean amount of cola in all the bottles filled that day differs from the target value of 300 ml? Carry out an appropriate test to support your answer.

Hypotheses:

$H_0: \mu = 300$ (mean amount of cola in bottles is 300ml)
 $H_a: \mu \neq 300$ (mean amount of cola in bottles is not 300ml)

Conditions: As stated, this is an SRS
 $6 \leq \frac{1}{10} N \rightarrow 60$. We can assume that at least 60 bottles are filled.

μ is stated, the distribution is approx normal

$\bar{x} = 299.03$ $s_x = 1.503$
 $n = 6$ $df = 5$ $t^* = -1.576$
 $p = .1760$

Using my calculator, I performed a T-Test. Since the p-value = .1760 and is greater than the significance level $\alpha = .05$, we fail to reject H_0 . There is not sufficient evidence to conclude that the mean amount of cola in a bottle is not 300ml.

2. The recommended daily allowance (RDA) of calcium for women between the ages of 18 and

2. The recommended daily allowance (RDA) of calcium for women between the ages of 18 and 24 years is 1200 milligrams (mg). Researchers who were involved in a large-scale study of women's bone health suspected that their participants had significantly lower calcium intakes than the RDA. To test this suspicion, the researchers measured the daily calcium intake of a random sample of 36 women from the study who fell in the desired age range. The Minitab output below displays descriptive statistics for these data, along with the results of a significance test.

| One-Sample T: Calcium intake (mg) | | | | | | |
|-----------------------------------|----|-------|-------|---------|-------|-------|
| TEST OF $\mu = 1200$ VS < 1200 | | | | | | |
| Variable | N | Mean | StDev | SE Mean | T | P |
| Calcium | 36 | 856.2 | 306.7 | 51.1 | -6.73 | 0.000 |

Do these data give convincing evidence to support the researchers' suspicion? Carry out a test to help you answer this question.

Hypotheses:

$H_0: \mu = 1200$ (The calcium intake is 1200mg)
 $H_a: \mu < 1200$ (The calcium intake is lower than 1200mg)

Conditions: As stated, this is an SRS.

$36 \leq \frac{1}{10} N \rightarrow 360$. We can assume that there are at least 360 women between ages 18-24
 μ is stated, we can assume that the data is approximately normal.

$\bar{x} = 856.2$ $s_x = 306.7$
 $n = 36$ $df = 35$ $t^* = -6.726$
 $p\text{-value} = .00000004$

Using my calculator, I performed a T-test. Since the p-value = .00000004 and is less than the significance level $\alpha = .05$, we reject the H_0 . There is sufficient evidence to conclude that the average calcium intake is less than 1200mg.

Is Caffeine Dependence Real?

Researchers designed an experiment to study the effects of caffeine withdrawal. They recruited 11 volunteers who were diagnosed as being caffeine dependent to serve as subjects. Each subject was barred from coffee, colas, and other substances with caffeine for the duration of the experiment. During one two-day period, subjects took capsules containing their normal caffeine intake. During another two-day period, they took placebo capsules. The order in which subjects took caffeine and the placebo was randomized. At the end of each two-day period, a test for depression was given to all 11 subjects. Researchers wanted to know whether being deprived of caffeine would lead to an increase in depression.

*Paired data test

Is Caffeine Dependence Real?

Testing same sample twice with a restriction.

The table below contains data on the subjects' scores on a depression test. Higher scores show more symptoms of depression.

| Results of a caffeine-deprivation study | | |
|---|-----------------------|----------------------|
| Subject | Depression (caffeine) | Depression (placebo) |
| 1 | 5 | 16 |
| 2 | 5 | 23 |
| 3 | 4 | 5 |
| 4 | 3 | 7 |
| 5 | 8 | 14 |
| 6 | 5 | 24 |
| 7 | 0 | 6 |
| 8 | 0 | 3 |
| 9 | 2 | 15 |
| 10 | 11 | 12 |
| 11 | 1 | 0 |

$H_0: \mu = 0$

$H_a: \mu > 0$

On my calculator, I performed a T-Test.

$\bar{x} = 7.3636$ $df = 10$

$S_x = 6.918$ $t = 3.53$

$n = 11$ $p\text{-value} = .0027$

Carry out a test to investigate the researchers' question.

Since the p-value is .0027 and is less than the significance level of $\alpha = .05$, we reject null hypothesis. There is sufficient evidence to conclude that the lack of caffeine increases depression.

Right vs Left

The design of controls and instruments affects how easily people can use them. A student project investigated this effect by asking 25 right-handed students to turn a knob (with their right hands) that moved an indicator. There were two identical instruments, one with a right-hand thread (the knob turns clockwise) and the other with a left-hand thread (the knob must be turned counterclockwise). Each of the 25 students used both instruments in a random order. The following table gives the times in seconds each subject took to move the indicator a fixed distance:

| Subject | Right thread | Left thread |
|---------|--------------|-------------|
| 1 | 113 | 137 |
| 2 | 105 | 105 |
| 3 | 130 | 133 |
| 4 | 101 | 108 |
| 5 | 138 | 115 |
| 6 | 118 | 170 |
| 7 | 87 | 103 |
| 8 | 116 | 145 |
| 9 | 75 | 78 |
| 10 | 96 | 107 |
| 11 | 122 | 84 |
| 12 | 103 | 148 |
| 13 | 116 | 147 |
| 14 | 107 | 87 |
| 15 | 118 | 166 |
| 16 | 103 | 146 |
| 17 | 111 | 123 |
| 18 | 104 | 135 |
| 19 | 111 | 112 |
| 20 | 89 | 93 |
| 21 | 78 | 76 |
| 22 | 100 | 116 |
| 23 | 89 | 78 |
| 24 | 85 | 101 |
| 25 | 88 | 123 |

Right vs Left

The project designers hoped to show that right-handed people find right-hand threads easier to use. Carry out a significance test at the 5% significance level to investigate this claim.

$p\text{-value} = .0039$

| Subject | Right thread | Left thread |
|---------|--------------|-------------|
| 1 | 113 | 137 |
| 2 | 105 | 105 |
| 3 | 130 | 133 |
| 4 | 101 | 108 |
| 5 | 138 | 115 |
| 6 | 118 | 170 |
| 7 | 87 | 103 |
| 8 | 116 | 145 |
| 9 | 75 | 78 |
| 10 | 96 | 107 |
| 11 | 122 | 84 |
| 12 | 103 | 148 |
| 13 | 116 | 147 |
| 14 | 107 | 87 |
| 15 | 118 | 166 |
| 16 | 103 | 146 |
| 17 | 111 | 123 |
| 18 | 104 | 135 |
| 19 | 111 | 112 |
| 20 | 89 | 93 |
| 21 | 78 | 76 |
| 22 | 100 | 116 |
| 23 | 89 | 78 |
| 24 | 85 | 101 |
| 25 | 88 | 123 |