Panel 1

Hypothesis Testing

Computed confidence interval to estimate pop. mean μ.
Now: Is $\mu = 15$ or not, yes or no! (and error estimate)

Ex: You buy 2% milk. That means that avg. fat content of milk is 2%.

You suspect it ain't so!

To test: Pick 100 bottles and measure avg fat content.
Say $\bar{x} = 1.1\%$. $\Rightarrow$ It's a lie.

1

Panel 2

If $\bar{x} = 1.99\%$ You be quiet!

$\Rightarrow$ Want to develop a Stat. Test of hypothesis

All Stat. tests have 4 components
1. Null-Hypothesis H_0 (status quo)
2. Alternative Hyp: H_a (what you think is true)
3. Test statistics (compute some #)
4. Conclusion (draw conclusion based on 3)

2

Panel 3

Ex: Machine dispenses coffee with 109mg caffein, according to the manufacturer. You think it is NOT true.

Select $N = 81$ cups, find $\bar{x} = 110$, $s = 5.0$.

150

$H_0: \mu = 109$

$H_a: \mu \neq 109$

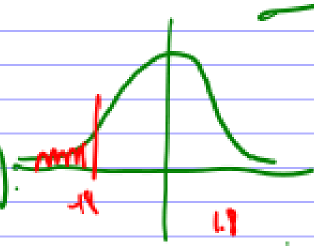
$$t = \frac{\bar{x} - \mu}{s/\sqrt{n}} = \frac{110 - 109}{5/9} = \frac{1}{5/9} = 9/5 = 1.8$$

it is 7% likely that $\mu = 109$ even though I measured $\bar{x} = 110$

$\Rightarrow$ inconclusive

$2P(t > 1.8) = 2 \cdot 0.036 = 0.072$

Conclusion: if p is small (< 0.05) $\Rightarrow$ Reject H_0



3

Panel 4

Test about mean μ

(1) $H_0: \mu = \#$

(2) $H_a: \mu \neq \#$

(3) $$t_0 = \frac{\bar{x} - \mu}{s/\sqrt{n}}$$

(4) Reject H_0 if $p = 2P(t > |t_0|)$ less than 0.05

Else the test is inconclusive!

4

Panel 5

A large supermarket chain sells longhorn cheese in one-pound (= *16* ounces) packages. As city inspector you weigh *100* randomly selected packages of cheese and note that the sample mean is *15.6* ounces, with a standard deviation of *2.0* ounces. You therefore suspect that the chain is miss-labeling the cheese and that the actual weight of a package is different from the stated *16* ounces. Use your data to test your suspicion against the null hypothesis that the average weight of a package is *16* ounces. Use $\alpha = 0.05$.

$H_0: \mu = 16$

$H_a: \mu \neq 16$

$z_0 = \frac{\bar{x} - \mu}{s/\sqrt{n}} = \frac{15.6 - 16.0}{2/\sqrt{100}} = \frac{-0.4}{2/10} = -0.4 \cdot \frac{10}{2} = -2$

$p = 2P(z \geq |z_0|) = 2P(z \geq 2) = 2 \cdot 0.0228 = \underline{0.045}$

Conclusion: reject H_0 and accept H_a, i.e. avg. is not 16 ounces!

5

Panel 6

Other Stats Test: Chi Square Test

H_0: 2 vars are indep

H_a: 2 vars are dependent

compute: χ^2 = some number

p = some prob.

If $p < 0.05$ then reject H_0 and accept H_a

→ vars are dependent.

6

Panel 7

A test was conducted to determine the length of time required for a student to read a specified amount of material while a low-level music was playing to see if students were distracted by the noise. All students were instructed to read at the maximum speed at which they could still comprehend the material. Fourteen students took the test, with the following results (in minutes):

$\bar{x} = 24$

25, 18, 27, 29, 20, 19, 25, ~~24~~, 32, 21, 24, 20, 24, 28 $s = 4.1$

The average reading time for students in a quiet environment is 22 minutes. Use an appropriate statistical test to determine whether noise is indeed distracting students.

$H_0: \mu = 22$

$H_a: \mu \neq 22$

$t_0 =$

$z_0 = \frac{\bar{x} - \mu}{s/\sqrt{n}} = \frac{24 - 22}{4.1/\sqrt{14}} = 1.9272$ | t_0

$2 \cdot 0.045 = 0.09$

$p = 2 \cdot P(z > z_0) = 2 \cdot P(z > 1.9272) = \cancel{2 \cdot 0.034 = 0.068} > 0.05$

should have used t-distr.

$\Rightarrow$ Test is inconclusive

7

Panel 8

2 Tests about Pop. mean

(1) $H_0: \mu = \#$

(2) $H_a: \mu \neq \#$

(3) $z_0, t_0 = \frac{\bar{x} - \mu}{s/\sqrt{n}}$ $\left(\begin{array}{l} z_0 \text{ if } n \geq 30 \\ t_0 \text{ if } n < 30 \end{array} \right)$

(4) $p = 2P(z > z_0)$. (if $n > 30$) if $p < 0.05$ $\Rightarrow$ reject H_0,

$= 2P(t > t_0)$. (if $n < 30$) else

inconclusive!

8

Panel 9

Student-t distribution

The t-statistic was introduced in 1908 by William Sealy Gosset, a chemist working for the Guinness brewery in Dublin, Ireland ("Student" was his pen name).Gosset had been hired due to Claude Guinness's policy of recruiting the best graduates from Oxford and Cambridge to apply biochemistry and statistics to Guinness' industrial processes.Gosset devised the t-test as a way to cheaply monitor the quality of stout. He published the test in Biometrika in 1908, but was forced to use a pen name by his employer, who regarded the fact that they were using statistics as a trade secret. In fact, Gosset's identity was known to fellow statisticians.

9