Panel 1

Hypothesis Testing

1. $H_0: \mu = \mu_0$
2. $H_a: \mu \neq \mu_0$
3. Compute $z = \frac{\bar{x} - \mu}{\frac{\sigma}{\sqrt{n}}}$
4. Decide
   - $p = 2 \cdot \text{Prob}(z < z_0) < 0.05$ then reject $H_0$.
   - else inconclusive.

P in error you commit if you reject $H_0$ even though it is true.

Panel 2

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 to which they could still comprehend the material. Fourteen students took the test, with the following results (in minutes):

25, 18, 27, 29, 20, 19, 25, 24, 22, 21, 24, 20, 24, 28

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.

$H_0: \mu = 22$
$H_a: \mu \neq 22$
$t = \frac{\bar{x} - \mu}{s/\sqrt{n}}$

$p = 2 \cdot \text{Prob}(t < t_0) = 2 \cdot 0.04 = 0.08$

= inconclusive!
Panel 3

**Test for Difference of Means**

Need 2 samples, want to compare means.

\[ H_0: \mu_1 = \mu_2 \]

\[ H_a: \mu_1 \neq \mu_2 \]

\[ \bar{x}_1 - \bar{x}_2 = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \]

\[ p = 2P(\nu > 1.96) < 0.05 \Rightarrow \text{null Ho, else inconclusive} \]

Panel 4

3. On average, do males outperform females in mathematics? To answer this question, psychologists at the University of Minnesota compared the scores of male and female eighth-grade students who took a basic skill math test. A summary of the test scores is displayed below.

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample Size</td>
<td>1764</td>
<td>1739</td>
</tr>
<tr>
<td>Mean</td>
<td>48.9</td>
<td>48.4</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>12.96</td>
<td>11.85</td>
</tr>
</tbody>
</table>

\[ H_0: \mu_1 = \mu_2 \quad (\text{i.e., both groups are equally good}) \]

\[ H_a: \mu_1 \neq \mu_2 \]

\[ t = \frac{\bar{x}_1 - \bar{x}_2}{s_{\bar{x}_1 - \bar{x}_2}} = \frac{42.9 - 48.4}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} = 0.9195 \]

\[ t = \frac{42.9 - 48.4}{0.9195} = 0.1 \]

\[ p = 2P(\nu > 1.96) = 2 \times 0.022 = 0.044 \quad \text{inconclusive} \]
Panel 5

Test for Independence

$H_0$: are they independent
$H_a$: are they dependent

$X^2 = \chi^2$ (via StatCrunch)

$p < 0.05$ and reject $H_0$, evidence inconclusive.

Panel 6

The “fear of negative evaluation” (FNE) scores for 11 bulimic female students and 14 normal female students are shown below (the higher the score, the greater the fear of negative evaluation). What is the average FNE score of bulimic female students and that of normal female students? Is there a significant difference between the mean FNE scores?

Bulimic students: 21, 13, 10, 20, 25, 19, 16, 21, 24, 13, 14
Normal students: 13, 6, 16, 13, 8, 19, 23, 18, 11, 19, 7, 10, 15, 20

$\mu_1 = 14.9, \sigma_1 = 4.9$

$\mu_2 = 4.1, \sigma_2 = 5.3$

$H_0: \mu_1 = \mu_2$
$H_a: \mu_1 \neq \mu_2$

$t_0 = \frac{\bar{x}_1 - \bar{x}_0}{s} = 1.81$

$s = \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}} = 2.04$

$p = 2P(t \geq 1.81) = 2 \times 0.04 = 0.08$ inconclusive

$df = n_1 + n_2 - 2 = 23$
Panel 7

So far our tests apply only to numeric cases!

Ex. Do you have health insurance?

As Canadian, support indip. for Quebec?

Set them up as proportions, consider experiment with

two outcomes. $S =$ success and $F =$ failure.

Ex. Person with health insurance: $S$ (1)

vote for independence: $F$ (0)

heads in a coin toss: $S$ (1)

$\pi$ be the probability of success.

$\pi (x=1) = \frac{11}{7} \quad \pi (x=0) = 1 - \frac{11}{7}$

Panel 8

Fact: $S = \sqrt{\pi \cdot (1-\pi)}$

Statistical Test for a proportion

To cover increasing costs of services, can do

(a) increase taxes  (b) decrease services

Let $H_0$ be the rate of success i.e. increase in taxes.

$H_0: \pi = 0.5$

$H_A: \pi \neq 0.5$

compute $Z = \frac{\bar{X} - \pi}{\sqrt{\pi(1-\pi)}}$

$\bar{X}$ is prop.

of $S$ on

$P = 2 P (Z > 0.5) \Rightarrow$ reject $H_0$, the sample would not be indistinguishable.
Say: 1000 voters. 12% - min tax, 49% - other revenue.