Two Sample Hypothesis Tests
Sections 21.1, 21.2, 21.3
Lecture 39

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Outline

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- To test a hypothesis concerning the difference in means between two populations, we follow the same 6 steps as before.
- Only the details have changed.

The Hypotheses – Difference of Means

- The null hypothesis will assert that there is no difference.

$$H_0 : \mu_1 = \mu_2$$

- Or we could write

$$H_0 : \mu_1 - \mu_2 = 0$$

The Hypotheses – Difference of Means

- The alternative hypothesis will be one of the following, depending on the circumstances

$$H_a : \mu_1 \neq \mu_2$$
$$H_a : \mu_1 < \mu_2$$
$$H_a : \mu_1 > \mu_2$$

- The level of significance is handled the same as before. State its value.

The Test Statistic

- The test statistic follows the usual pattern: Observed value minus the expected value (0) divided by the standard error.
- In this case, that gives us

$$t = \frac{\overline{x}_1 - \overline{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}.$$

- The remaining steps are done in the same way as in the earlier examples.

Example

Example (Hypothese Test – Difference of Means)

- I am trying to choose between two wood stoves.
- If all else is equal, I would like to buy the one that gives off less emissions.
- I collected 9 measures from Stove #1:

$$1.25, 0.85, 0.44, 1.49, 1.35, 1.50, 0.86, 1.17, 1.52$$

  and 7 measures from Stove #2:

$$1.36, 1.43, 1.24, 1.19, 1.24, 1.78, 1.54$$

- Test the hypothesis that the emission rates are the same.

Example

Example (Hypothese Test – Difference of Means)

(1) The hypotheses are

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

(2) We will let $\alpha = 0.05$.

(3) The test statistic is

$$t = \frac{\overline{x}_1 - \overline{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}.$$

Example

Example (Hypothesis Test – Difference of Means)

(4) We have

Sample 1	Sample 2
$\overline{x}_1 = 1.159$	$\overline{x}_2 = 1.397$
$s_1 = 0.3713$	$s_2 = 0.2989$
$n_1 = 9$	$n_2 = 7$

Example

Example (Hypothesis Test – Difference of Means)

(4) Then

$$t = \frac{1.159 - 1.397}{\sqrt{\frac{0.3713^2}{9} + \frac{0.2089^2}{7}}}$$

$$= -\frac{0.238}{0.1468}$$

$$= -1.621.$$

(5)

$$p\text{-value} = \texttt{tcdf(-E99,-1.621,14)}$$

$$= 0.0637.$$

(6) Do not reject H_0. We cannot prove that they stoves have different emission rates.

Assignment

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- Read Section 21.1, 21.2, 21.3.
- Check Your Skills: 25.
- Exercises 29(c), 30, 31, 32, 34.