



About the Mathematics

This activity allows students to experiment with different alpha levels and alternative hypotheses to investigate the relationship among types of error and power.

This activity will give students the following opportunities:

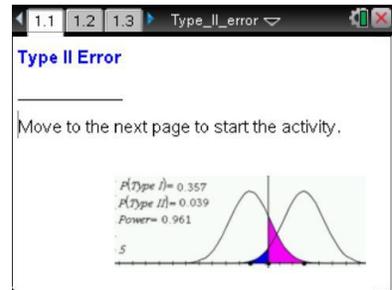
- Experiment with different sample sizes to investigate their relationship with Type I errors, Type II errors, and power.
- Experiment with different standard deviations to investigate their relationship with Type I errors, Type II errors, and power.

Math Objectives

- Students will recognize that increasing the probability of a Type I error decreases the probability of a Type II error and vice versa.
- Students will recognize that the sum of the probability of a Type II error and power is 1.
- Students will recognize that as the effect size—the difference between the null hypothesized value and the truth—increases, the power increases (it is easier to see the effect).
- Students will recognize that increasing the sample size decreases the probability of Type I and Type II errors and increases the power.
- Students will recognize that decreasing the standard deviation decreases the probability of Type I and Type II errors and increases the power.
- Students will use appropriate tools strategically (CCSS Mathematical Practices).

The Problem Situation

The manufacturer claims that the salt content in mg of half a cup of a certain cereal is supposed to be normally distributed with a mean of 2.0 and a standard deviation of 0.1, $N(2.0, 0.1)$. An inspector takes a sample of size 50. The inspector will reject the entire batch if the mean is significantly different from 2 mg at the 5% level.



TI-Nspire™ Technology

Skills:

- Open a document
- Move between pages
- Click on a minimized slider
- Grab and drag a point

Lesson Materials:

Type_II_Error.tns

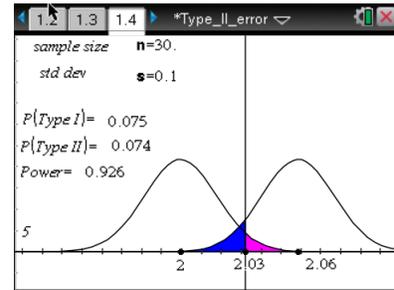
Visit www.mathnspired.com for lesson updates.



Using the Document

Page 1.4: Graph and Number Line

The horizontal axis on Page 1.4 measures mg in hundredths. The curve on left shows the null hypothesis model ($\mu = 2.0$), and the curve on the right shows the alternative hypothesis model ($\mu \neq 2.0$). There are three dots on the number line of the graph—two mark the centers of each curve, null and alternative hypotheses, and one marks the critical value.

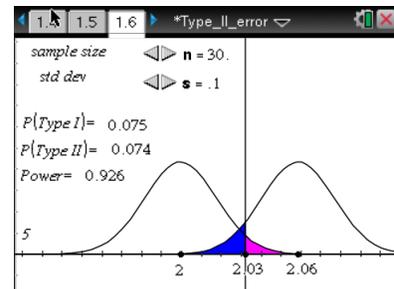


The lighter shaded pink region represents a Type I Error, incorrectly rejecting a true null hypothesis—this would happen if the inspector was unfortunate and drew an unusual sample that mistakenly rejected the null hypothesis when it was true. The darker shaded blue region represents a Type II error, failing to reject a false null hypothesis. The probability of a Type II error is β . The **power** of a statistical test is the probability of rejecting a false null hypothesis. Power has probability $1 - \beta$. It is the region to the right of the vertical line representing the hypothesized value.

Dragging the points will change the centers of the curves, the critical value, and the probabilities shown. Dragging the point attached to the vertical line changes the critical value and the probability of a Type I error (alpha)—values close to 0.01 or 0.05 are typical. The alpha value is usually predetermined before conducting a statistical test.

Page 1.6: Changing Sample Size and Standard Deviation

Clicking the top arrow will change the sample size and display the corresponding errors and power. Clicking on the lower arrow will change the standard deviation of the populations and display the corresponding errors and power. (Note that the points on Page 1.6 cannot be dragged.)



Page 1.8: Investigating the Relationships

On Page 1.8, the sample size and standard deviation as well as the points on the x-axis can be changed.

Possible Applications

This activity can be used in conjunction with the Statistics Nspired activity *Power*.