Lesson 3, Part B   Random Assignment

"A hernia happens when part of an internal organ or tissue bulges through a weak area of muscle. Most hernias are in the abdomen."[1]

1)   If you or your child were having surgery for a hernia, would you rather have three small incisions or one large incision? Why?

Credit: Fotolia/s_l

Objectives for the lesson

You will understand:

☐   The need for random assignment in experiments.

You will be able to:

☐   Describe a process for randomly assigning subjects to experimental groups in a given experiment.

Suppose that the parents of 30 children with hernias were asked to allow their children to participate in an experiment comparing the two surgical methods. The age of each child is shown in the table.[2]

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[1] http://www.nlm.nih.gov/medlineplus/hernia.html

[2] Adapted from an experiment conducted by Koivusalo, A. I., Korpela, R., Wirtavuori, K., Piiparinen, S., Rintala, R. J., & Pakarinen, M. P. (2009). A single-blinded, randomized comparison of laparoscopic versus open hernia repair in children. Pediatrics, 332–336.

Subject Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Age	12	11	9	8	11	10	11	10	7	6	12	10	10	9	10

Subject Number	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Age	7	7	8	6	9	7	9	8	11	9	12	12	11	12	12

2)   Describe a method for randomly assigning each child to either Method 1 (laparoscopic repair with three small incisions) or Method 2 (open repair with one large incision).

3)   Work with a partner to randomly assign the children to a surgical method. For example, which method of surgery will Subject Number 1 undergo? What is Subject Number 1's age? (Note: It is possible that the two groups will be different sizes.)
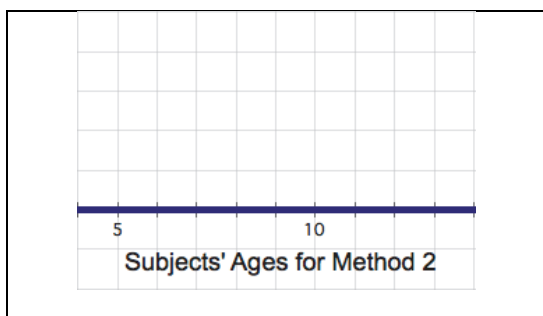
Method 1 Group

Subject Number	Age

Method 2 Group

Subject Number	Age

4) One person in your pair should create a dotplot for Method 1's ages and calculate the mean of those ages. The other person should create the dotplot and calculate the mean for Method 2's ages.

Mean age for Method 1:
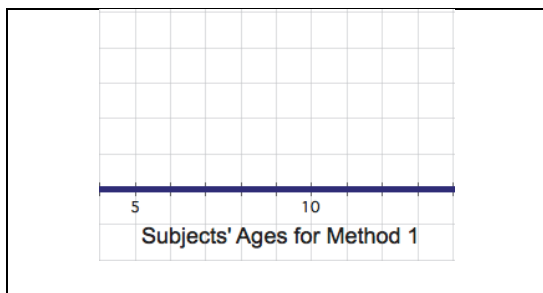
Subjects' Ages for Method 1

Mean age for Method 2:

Subjects' Ages for Method 2

5) Does one group have a substantially higher mean age or are they about the same? Explain your reasoning.

6) Compare your dotplot to a few of your neighbor's dotplots. Considering the dotplots and the averages, do you think the random assignment was successful in creating groups that were similar with respect to the ages of the children in the groups?

Lesson 3, Part B

Random Assignment

Overview and student objectives

Overview

In this lesson, students explore random assignment. It is likely that the idea of randomizing assignment of the subjects to the treatments arose during the Lesson 3, Part A discussion as students designed experiments to control extraneous variables. Introducing this idea early will help students tackle the more complex contexts that appear in Lesson 3, Part B.

Objectives

Students will understand:

- The need for random assignment in experiments.

Students will be able to:

- Describe a process for randomly assigning subjects to experimental groups in a given experiment.

> **Lesson Length**: 25 minutes
>
> **Prior Lesson**: Lesson 3, Part A, "Planning an Experiment"
>
> **Next Lesson:** Lesson 3, Part C, "Control Groups and Placebos" (25 minutes)
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> **Constructive Perseverance Level**: 1
>
> **Outcomes**: SD1, SD3, DE1, DE2
>
> **Goals**: Problem Solving, Reasoning
>
> **Related Foundations Outcome:** N8

Suggested resources and preparation

Materials and technology

- Computer, projector, document camera

- Preview Assignment 3.AB

- Student Pages for Lesson 3, Part B

- Practice Assignment 3.AB

- Tape

- Each pair of students will need a coin or some type of random number generator.

- Consider creating one long table by cutting out and piecing together the data shown above question 2 on the Student Page. This activity will reinforce that this table represents one group, to distinguish it from the two groups that are formed on the second page of the student version of the lesson.

Prerequisite assumptions

Students should be able to find the mean of a set of numbers.

Making connections

This lesson:

- Connects back to the Steps in a Statistical Investigation.

- Connects forward to control groups and inference.

Background context

In Preview Assignment 3.AB, students were introduced to the two contexts that are analyzed in this lesson. They were asked to identify the treatment and response variables in each case.

Suggested instructional plan

Frame the lesson

(5 minutes)

Student Page	Question 1
	• Allow time for students to think about the surgery options given at the top of the Student Page.
	• Some students may focus on the number of incisions, while others may focus on the size of the incision.
	• Take student responses. To set the stage for the remainder of the exploration, ask:
Guiding Questions	o "Which option do you think will lead to a shorter recovery time?"
	o "What are some other factors that might affect recovery time?"
	o "What about age? Could that affect recovery time? What about overall health?"
	• Point out that if we are going to conduct an experiment using these two surgical methods, it is not possible to have participants who are all the same age and health status. Therefore, we must strive to make sure that the groups of participants undergoing each method are similar to one

another in terms of having a variety of ages and a variety of health conditions.

- Transition to the lesson activities by briefly discussing the **Objectives for the lesson**.

Lesson activities

(15 minutes)

Preparation for Pair Work   Question 2

- Ensure that students understand there is only one table above question 2; it is split because of space restrictions. Consider creating one long table to show students, as noted in the **Suggested resources and preparation** section of these notes.

- Encourage students to be specific in their descriptions, but make sure that students are using random assignment. See the sample answers in the Student Pages at the end of these notes.

- Debrief student methods here. In the next question, students will complete the random assignment. If they do not have the materials to carry out their method, they will get other ideas during this discussion.

Guiding Questions

- "Using your method, does each child have the same chance of being in either group?"

- "Will each method create groups of the same size? Does it matter?"

Questions 3–5

Pair Work

- Have students work in pairs to complete the random assignment. Working in pairs will ensure a large number of dotplots for the class.

- One student should have the table of student ages showing face up. The other student should have the blank table showing for recording the results of the random assignment. One person executes the random assignment while the other records. The data can be shared later.

- Watch for students who may be picking the children rather than randomly assigning. Ensure that they are marking off the children as they are chosen so that the same child is not chosen more than once.

- Encourage students to label their dotplots appropriately.

Gallery Walk   Question 6

- Have each pair of students tape one set of dotplots on the wall. Encourage them to walk around and look at dotplots created by other student pairs.

- Ask, "Considering the dotplots and the averages, do you think the random assignment was successful in creating groups that were similar with respect to the ages of the children in the groups?" [Answer: Although student pairs are likely to have two different means, about half of the groups should have a larger mean for the Method 1 group while the other half should have a larger mean for the Method 2 group. Therefore, this situation would indicate that the random assignment was successful in creating groups that were similar with respect to the ages of the children in the groups.]

- Reinforce the idea from Lesson 3, Part A that we are not trying to get rid of extraneous factors, but rather to make all experimental groups as similar as possible with respect to extraneous factors. Possible clarifying statement for students: "Think about it as 'balancing out' the occurrence of the extraneous variables across all experimental groups."

- Key point: Not every group ends up with the same results or the same averages, but the age distributions in the two groups should look pretty similar. There will be variability across the random assignments but it is very unlikely that it will lead to one group having much larger ages than the other.

Wrap-up/transition

(5 minutes)

Wrap-up
- Random assignment tends to create comparable groups. It does not tend to favor one experimental condition over the other in terms of age. This grouping will be true for any variable that could potentially affect recovery time, such as severity of hernia, and also for variables that the researcher does not even know about.

- The key advantage to random assignment in an experiment is the ability to draw a cause-and-effect conclusion about the effect of the treatment variable on the response variable.

- Caution: Remind students that using random assignment is different than using random sampling to generalize results from a sample to a larger population.

Transition
- Have students refer back to the **Objectives for the lesson** and check the ones they recognize from the activity. Alternatively, they may check objectives throughout the lesson.

- "What if we told the Method 2 group that it takes much longer to recover from the large incision method. Do you think this information would impact their recovery?"

- "If the researchers told you that they might cut open your child and then sew the incision back up without doing anything, would you agree to the surgery?"

Suggested assessment, assignments, and reflections

- Give Practice Assignment 3.AB.

- Give the Preview Assignments, if any, for the lesson activities you plan to complete in the next class meeting.