**Big Idea/ Topic**

- Draw inferences and conclusions based on data.

**Standard(s) Alignment**

- **MGSE9-12.S.IC.5** Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.

- **MGSE9-12.S.IC.6** Evaluate reports based on data. For example, determining quantitative or categorical data; collection methods; biases or flaws in data.

**Diagnostic Assessment**

- **Two Way Table Diagnostic Question Set**

  In this four-question diagnostic activity, students will be asked to complete two-way tables. Students will also be asked to answer questions about probability and likelihood of events occurring based upon table results.
Instructional Design

Desmos Activity: **Finding Associations**

Engage

1 Warm-Up

The RMS *Titanic* was a British passenger ship that sank on April 15, 1912, after striking an iceberg.

Of the **2226** people on the ship, **703** survived and **1523** died.

What percentage of the passengers survived?

**Teacher Moves**

Tell students that in this lesson, they will take a closer look at the percentage of *Titanic* passengers who survived, broken down by age, gender, and class. Students will explore data and engage in courageous discussions that might elicit strong emotions. To prepare, consider thinking about the culture of your classroom, what responses are likely to emerge, and how you will react to them.

Teaching Tolerance’s [guide to difficult conversations](#) is a resource that may be helpful for these types of conversations.

Read the student-facing text on Screen 1 aloud to the class, or ask a student to do so. Then consider asking students if they know anything about the sinking of the *Titanic*.

Direct student attention to the calculator button near the top of the screen. Encourage them to use it whenever they find it helpful throughout the lesson.

Consider using pacing to restrict students to this screen.

**Image Credit**

F.G.O. Stuart (1843–1923)
RMS *Titanic* departing Southampton on April 10, 1912.

**Sample Responses**

32%
Explore

2 Prediction #1

The table shows how many women, men, and children were on the *Titanic*.

Do you think the data will show an association between survival and passenger type?

**Teacher Moves**

Tell students that their task is to explore whether there is an association (i.e., relationship) between survival rates and passenger type (women, men, and children) for the RMS *Titanic*.

Give students one minute of quiet think-time and a few minutes to discuss with a partner. Invite several students to share their responses.

Consider using pacing to restrict students to Screens 2–5, one screen at a time.

**Sample Responses**

*Responses vary.*

- **Association.** Adults tend to be stronger than children, so we might see higher survival rates among women and men than among children.

- **Association.** I recall hearing something about “women and children first” in relation to the sinking of the *Titanic*. Maybe that means women and children were given first opportunity for lifeboats. If so, their survival rates would be higher than the survival rate for men.

- **No association.** Since most of the passengers and crew died, I don’t think there will be any patterns in the survival data.

3 Data Set #1

Based on the data, is there evidence of an association between survival and passenger type?

**Teacher Moves**

Give students 1–2 minutes of quiet think-time and a few minutes to discuss with a partner. Highlight unique answers to show the class. Ask students to justify their responses and critique each other’s reasoning.

**Sample Responses**

*Association*

*Responses vary.*

- Even though approximately the same number of women and men survived, a greater ratio of men died.

- Women had the highest survival rate. Men had the lowest survival rate.

- The overall survival rate was about 30%. Women and children survived at a much higher rate (about 75% and exactly 50%), while men survived at a slightly lower rate (about 25%).
One way to look for associations with categorical data is to create a **relative frequency table**.

This shows **percentages** rather than quantities.

For example, 324 out of 434 women survived:

\[
\frac{324}{434} \approx 0.75 \text{, which is } 75\%.
\]

Complete the rest of the table.

**Teacher Moves**

Use the student view of the dashboard to demonstrate how to use the scientific calculator (available in the center of the navigation header) to determine the percentage of women who survived. Then ask: **How can we calculate the percentage of women who died?** [Use the calculator to divide 110 by 434, multiply by 100, and round to the nearest whole number. Or, subtract 75% from 100%]

After that brief demonstration and discussion, give students 2–3 minutes to complete the rest of the table. Use the summary view of the dashboard to check student progress. Offer individual support where needed, or lead another whole-class discussion if enough students are struggling.

**Sample Responses**

- **Women**: 75% and 25%
- **Men**: 19% and 81%
- **Children**: 50% and 50%

- **Synchronous**: Complete the Desmos activity during synchronous learning, either face-to-face, virtual, or blended.
- **Asynchronous**: Using the teacher dashboard, unrestrict screens two, three, and four. Give students time to complete the screens and provide feedback. Ensure that enough time is provided for students to participate and respond to your feedback and edit their responses.
- **Unplugged/Offline:**
  - Part One: Provide printed relative frequency tables for students to complete.
  - Part two: Students will display the same data using other representations such as a bar graph.
  - Part three: Encourage students to make predictions based on the data.
  - Part four: Students will analyze printed data about traffic accidents.
Teacher Moves

Give students one minute of quiet think-time. Then ask students to discuss with a partner. Invite several students to share their responses.

Some students may wonder why the relative frequency table has a total column, but not a total row. This is because we can only ask one percentage-style question at a time. For example, this relative frequency table answers questions like this: What percentage of women survived? We could ask a different type of question of the original data set: Of those who survived, what percentage were women? To explore this type of question, we would remove the total column from the right and add a total row to the bottom of the table.

Sample Responses

Responses vary.

- The table and graph on the left show frequencies. The table and graph on the right show percentages.
- The frequency table has a total column and a total row. The relative frequency table has a total column, but not a total row.
- The frequency table and bar graph (on the left) make it easier to answer this question: How many men died?
- The relative frequency table and segmented bar graph (on the right) make it easier to answer this question: Is there an association between survival rates and passenger type?
Let's use graphs to explore a new relationship.

Do you think the data will show an association between survival and ticket type?

**Teacher Moves**

Tell students that their task is to explore a new relationship (survival rates vs. ticket type) in the same overall context. Explain that first-class tickets were the most expensive, and third-class tickets were the least expensive.

Give students one minute of quiet think-time and a few minutes to discuss with a partner. Invite several students to share their responses.

Consider using pacing to restrict students to Screens 6–8.

**Sample Responses**

*Responses vary.*

- **Association.** The ship sank in the early morning hours. If most people were asleep, and if the location of the sleeping quarters were different for each ticket type, then we might see higher or lower survival rates based on ticket type, depending on how difficult it would have been to get from one’s room to a lifeboat.

- **No association.** In the chaos of a sinking ship, I don’t think anyone would have time to check what type of ticket someone purchased. I expect the survival rates to be approximately the same for each ticket type.
Based on the data, is there evidence of an association between survival and ticket type?

**Teacher Moves**

Give students 1–2 minutes of quiet think-time and a few minutes to discuss with a partner. Highlight unique answers to show the class. Ask students to justify their responses and critique each other’s reasoning.

Consider asking, “Why do you think there is an association between survival rates and ticket type?” (While room location was in fact determined by ticket type, and physical barriers did contribute to lower survival rates among those who purchased second- and third-class tickets, the full story includes horrifying acts and attitudes rooted in classism and racism. To learn more, refer to [http://www.ic BYU see.org/titanic.html#notes](http://www.ic BYU see.org/titanic.html#notes), especially the “Class Distinctions” and “Women and Children First?” sections.)

**Sample Responses**

**Association**

*Responses vary.*

- First-class ticket holders had the highest number of survivors (about 200) and the highest survival rate (about 60%).
- Second-class ticket holders had the lowest number of survivors (about 120) and the second-highest survival rate (about 40%).
- Third-class ticket holders had the lowest survival rate (about 25%).
- More third-class ticket holders died (about 540) than first- and second-class ticket holders combined.

The data shows responses from 110 people who were asked whether they liked the food and the service at a restaurant.

Is there an association between liking the food and liking the service at this restaurant?

**Sample Responses**

**Association**

*Responses vary.*

- The relative frequency table shows that 90% of those who liked the food also liked the service, while only 30% of those who didn’t like the food did like the service.
- The segmented bar graph shows that those who liked the food generally liked the service, while those who didn’t like the food generally didn’t like the service.
Consider the following claim about the RMS Titanic:

"Women and men had nearly identical survival rates because 324 women survived and 323 men survived."

Is this claim correct?

Teacher Moves

Give students 2–3 minutes to respond to this question and a few minutes to share their responses with their partner. Then follow with a whole-class discussion. Use the teacher view of the dashboard to highlight unique answers for the class.

Consider using pacing to restrict students to screens 9-11.

Sample Responses

No

Responses vary. Even though the frequency of survivors is almost the same (324 for women, 323 for men), the percentages of survivors is dramatically different (75% for women, 19% for men).

- **Synchronous:** Complete the Desmos activity during synchronous learning, either face-to-face, virtual, or blended.
- **Asynchronous:** Using the teacher dashboard, unrestrict screens five through ten. Give students time to complete the screens and provide feedback. Ensure that enough time is provided for students to participate and respond to your feedback and edit their responses as needed.
- **Unplugged/Offline:** Provide students with access to graph paper and allow students to engage in the questions presented on screens five through ten. Ask students to complete the questions and have them submit responses via email/text/phone. Provide feedback, share these responses with other students, and share other students’ responses with them.
Reflect

11 Extend Your Thinking

The data shows how many Americans died in 2010 from traffic-related accidents versus other causes.

On paper, answer the following:

1. Describe any relationships or patterns that you see.

2. What is a question you could use this data to answer?

3. What is something you’re wondering about after looking at this data?

Teacher Moves

This screen takes a close look at traffic-related deaths broken down by whether the death was a teenager or an adult. If you think traffic-related accidents (especially teenage ones) are an area of trauma for your students, consider skipping this screen.

This screen is designed as an extra challenge for students who finish Screens 8–10 before the class discussion on Screen 10. Consider inviting these students to share responses with each other in place of a whole class discussion.

Sample Responses

Responses vary.

Students will write their responses about traffic-related accidents on paper and share them with each other and possibly the class if time allots.

- **Synchronous: Think-pair-share.** First, students work independently to write their responses. Next, students pair up and share their responses with each other. Finally, students engage in a large group discussion to discuss their responses. If you are working synchronously online, you might explore your ability to have breakout rooms to allow students to work in groups.

- **Asynchronous: Virtual: Think-Pair-Share.** First, students work independently to write their responses. If you are able to group your students, you might consider having them work together to discuss their responses.

- **Unplugged/ Offline:** Instruct students to complete their responses about traffic-related accidents.

In this activity, students use relative frequencies displayed in tables and in segmented bar graphs to identify possible associations between variables in data related to the sinking of the RMS Titanic. First, students explore possible associations between survival rates and passenger type (women, men, and children). Later in the activity, students explore possible associations between survival rates and ticket type (first-class ticket, second-class ticket, and third-class ticket).
Evidence of Student Success

Formative Assessment Questions:

- Can you describe the data from a relative frequency table?
- Can you describe the data from a segmented bar graph?
- Can you identify possible associations between variables in data related to the sinking of the Titanic?
- What are possible associations between survival rates and ticket type?

Student Learning Supports

Establish mathematics goals to focus learning.

- Make instructions and expectations clear for the activities.
- Make explicit connections between current and prior lessons or units.

Facilitate meaningful mathematical discourse.

- Explicitly model and teach good “discussion board” etiquette.

Pose purposeful questions.

- Predetermine when you will call on the student or use the pause feature within the activities.
- Break class into small discussion groups to work collaboratively and then have groups report back to the whole group.

Support productive struggle in learning mathematics.

- Offer outlines and other scaffolding tools and share tips that might help students learn.
- Provide feedback using the feedback feature within activities and offer corrective opportunities.
- Consider the pacing of the lesson.

Elicit and use evidence of student thinking.

- Anticipate any misconceptions or questions students might have about the task, materials or technology. Proactively address them with readily available and accessible resources such as Mathbits two-way frequency tables tutorial.

Engaging Families

Students can deepen their understanding of drawing inferences and conclusions based on data by completing the following activities asynchronously.

- Complete this Open Middle Problem with a family partner and discuss:
  - Open Middle Tile Puzzle (use numbers one through nine)
  - Answers Open Middle Tile Puzzle (use numbers one through nine)

- Practice problems with two-way frequency tables. Students and families can work through these self-checking practice problems. These questions are printer friendly, too. Students and their families can attempt the problems on paper before checking for feedback online.