



Name: _____

Date: _____

Too Many to Count

Diagnostic Assessment

1. Tyler swims at a constant speed, 5 meters every 4 seconds. How long does it take him to swim 114 meters?

distance (meters)	time (seconds)
5	4
114	

2. A factory produces 3 bottles of sparkling water for every 8 bottles of plain water. How many bottles of sparkling water does the company produce when it produces 600 bottles of plain water?

number of bottles of sparkling water	number of bottles of plain water

3. A certain shade of light blue paint is made by mixing $1\frac{1}{2}$ quarts of blue paint with 5 quarts of white paint. How much white paint would you need to mix with 4 quarts of blue paint?
4. For each of the previous three situations, write an equation to represent the proportional relationship.

Engage



Watch the video [2022 AJC Peachtree Road Race](#)

The Peachtree Road Race occurs in Downtown Atlanta every 4th of July.

1. Estimate the number of people you think ran in the first race in 1970.
2. Estimate the number of people you think ran in the race in 2022.

60,000 people must pre-register before the Peachtree Road Race. This fact of information shows that this is not a question where we would need to estimate the crowd. Any time tickets are sold, the promoter can control the size of the crowd. But what about outdoor venues, do they require strict adherence to public safety rules? How does the fire Marshall control the number of people who can attend a gathering, dine in a restaurant, or even stand in an elevator? Each of these instances has limited space.

What if a situation does not have an enclosed space?

3. How many people attended the 2022 Macy's Thanksgiving Day Parade?
4. How many people normally visit Time Square in New York City for New Year's Eve?
5. How many people attended the public portion of the Presidential Inauguration?
6. When would the media choose to overestimate a crowd?
7. When would the media intentionally under estimate a crowd?
8. When does it benefit an organization to overestimate or underestimate a number?
9. Are there instances where you have doubted the numbers quoted by a source? Can you list them?

Explore

Estimating the number of people in a large crowd (for example, watching a parade or attending/marching in a political rally) is quite challenging and often leads to controversies. One method sometimes used is to focus on a small section of the crowd, such as a rectangular area.

The most common technique for counting crowds at protests and rallies is Jacobs' method, named for its inventor, [Herbert Jacobs](#). Jacobs' method involves dividing the area occupied by a crowd into sections, determining an average number of people in each section, and multiplying by the number of sections occupied. New technologies are sometimes used to assist such estimations which include: lasers, satellites, aerial photography, 3-D grid systems, recorded video footage and surveillance balloons. Paul Yip and Ray Watson, published in the statistics journal *Significance*, a new technique to estimate crowd sizes based on satellite and aerial photography. Yip and Watson introduced the term “mosh-pit density,”. “Mosh-pit density” was defined as one person per 2.5 square feet... which is approximately one person in a 1.5-foot x 1.5-foot area.

Scientists estimate the average number of people in a section, based on **algorithms**: for low-density (one person per 10 square feet, when crowds might have an arms-length between them), high-density (one person per 4.5 square feet, when they're shoulder-to-shoulder), and “mosh-pit density” (one person per 2.5 square feet).

1. Make a square measuring 5 feet by 5 feet, and have your friends stand inside it as if they are watching a band at a small club. Count the number of your friends that comfortably fit in the rectangle and find the ratio of this number to the rectangle's area. Explain in your own words what this ratio means.
2. Use this value to estimate the size of a crowd that is 10 feet deep on both sides of the street standing along a 1-mile section of a parade route.
3. One rule of thumb for estimating crowds is that each person occupies 2.5 square feet. Use this rule to estimate the size of the crowd watching a parade along the 1-mile section of the route in Question 2.



Apply

1. Consider the situation of filling your classroom full of tennis balls. With a partner, take 5 minutes and make an estimate of the number of tennis balls you believe will be required to fill the room. Do you think your estimate is too small or too large? Why?
2. Using a tape measure to find the length, width, and height of your classroom. Make the following assumptions: the room is totally empty of any furniture, the room has been squared off of any room indentations, and you are using a standard size tennis ball.



Test & Reflect

1. In determining your group's estimate, what mathematical model of a tennis ball did you use?
2. What model of the classroom did you use?
3. Did you make other simplifications or assumptions (for example, assuming there are no desks in the room)?