Math from the Street—Problem-Solving

Why percents are important

A quick glance at today's print or on-line headlines, stock market reports, news, sports stats, and advertising flyers will reveal something common to all: math facts, symbols, and/or images. Information about survey results is communicated in the form of percentages and graphs.

The findings of medical studies include measurement units and ratios. Weather reports are based entirely on predictions based on experimental and theoretical probabilities. Mathematics is at the heart of a multitude of decisions, from economical electrical power generation and aviation safety; to construction management and mutual fund investments; and, weather predictions to maximizing yards for a running back in football.

Experts use statistics to evaluate the quality of information. They use models to quantify complex problems in order to suggest possible solutions in a particular context, and then rely upon probability to predict the likelihood of success for each.

Most of our day-to-day interactions with percentages, measurement and ratios come in the form of relatively simple applications of math…for example, calculating the final price for an item with multiple discounts, estimating the time for a road trip or predicting the outcome of a game. If our solutions to these common problems are wrong, there is usually no consequence other than a damaged bank account, a sibling asking repeatedly, "are we there, yet?" or a chance to be a good sport and congratulate the "other" team on its success.

But there may be times in our life when it is very important to understand how to apply some simple rules about percents and units in order to make very important decisions for ourselves or a loved one. For example, if a family member is diagnosed with a heart condition or cancer, the first thing we want to know are the chances for survival and the evaluation of treatment options. While physicians cannot use statistics and percentages to predict what will happen to an individual, the information is important for understanding general trends for the purposes of decision-making.

A few strategies for percent calculations

The word percent comes from the Latin per centum, meaning "per 100."

A discount of 50% is the same as a half-price sale. A discount of 25% is the same as paying 75% of the original price.

Here is a question like the one in the video: is a discount of 50% off the original price, followed by a discount of 30% off the sale price, the same as a discount of 80% from the original price?

To illustrate the point, we'll assume the item costs $100 at the start.

A discount of 50% is the same as $\frac{1}{2}$ off the original price, or a reduction of $50, to give a reduced price of $50. If we now reduce the discounted price by 30%, how much will be deducted? Since 10% of $50 is $5, we know that 30% is $15. So the final price is $35.00 ($50 - $15).

A discount of 80% would mean that the item cost 20% of the original price, or $20, which means that a discount of 50% followed by a discount of 30% is not the same as a discount of 80%.

It is helpful to work with friendly numbers whenever we encounter percentage problems. Use 50% (one half), 25% (one-fourth), 10% (one-tenth) as “anchor” amounts and then double, half or multiply as needed to find your answer. This strategy comes in handy when calculating tips at the restaurant – no need for YOU to use the automated button on the wireless payment terminal!

Standard Units

Measurement tools and skills have a variety of uses in everyday life. The ability to use measuring tools, rulers, thermometers, scales, and to estimate with these tools, are necessary skills that enable us to quantify the world around us. They can tell us how tall we are, how hot we are, how much we drink, how heavy we are, and how far it is from here to there. Basic measures of distance and time allow us to calculate speed and acceleration and ultimately tell us how fast we need to project a rocket to allow it reach the Moon, and how populations change and grow.

Many years ago, people used parts of their body to measure things. For example, they used to measure things by the width of a thumb; however, since people have different thumb sizes, errors resulted and “standardized” measures were introduced. As early as the middle of the tenth century it is believed that the Saxon king Edgar kept a "yardstick" at Winchester as the official standard of measurement. A traditional tale tells the story of Henry I (c. 1100-1135), who decreed that the yard should be "the distance from the tip of the King's nose to the end of his outstretched thumb." In the 14th century, King Edward II of England ruled that 1 inch equaled 3 grains of barley placed end to end lengthwise. The ancient Roman soldiers marched in paces, which were the length of a double step, about 5 feet and 1,000 paces was a mile. Today, a pace is the length of one step, $2\frac{1}{2}$ to 3 feet or approximately 1 m.

To be informed citizens, we must know what measurement units are communicating to us. We must know the quantity involved in each unit, the correct language for naming each unit, and the conventions for writing measured amounts using approved symbols. Are we measuring length (metre [m]), area (square metre [m^2], volume (cubic metre [m^3], mass (gram [g]) or time (second [s])?

It is important to understand that units of measure never change, but there are real-world references that we can use to help us to visualize and estimate the measures. One metre is 100 centimetres whether we are measuring vertically, horizontally or diagonally, and is approximately equal to the height of a standard doorknob. One centimetre is about the width of a fingernail. One millimetre is about the thickness of one dime. One millilitre is about a drop of liquid from an eyedropper and one gram is about the mass of one candy-coated peanut. One kilogram is about the mass of 1L of water or approximately the same as 7 apples. When you say "one elephant" that's how long one second is. To count to one minute you need to say, " one elephant, two elephants, etc. all the way to sixty elephants!

Just as you can't add apples and oranges, in math, we cannot add millilitres to seconds or measure time in grams. Measurement units are precise and specific with respect to what is being measured and in the magnitudes of the measures.

Measurement Matters

You probably know someone who loves to bake. When you watch him, it seems like he just tosses this and that into a bowl… then *Abracadabra*… suddenly some delicious cookies, or a pie, or cake that is equally as delicious appears for you to share! It seems like magic, so you may wonder how important it is to be accurate in measuring. The answer is: *very important.* Proper measuring is critical to baking. Baking is a science, and when you mix together ingredients, you're creating chemistry, (in this case) edible chemistry, so being precise is important. There is balance between flour, leaveners, fats, and liquids.

Extra salt or baking soda can ruin a batch of cookies. Too much flour makes muffins taste dry and bland. Every experienced baker knows that accuracy in measuring is the key to success of any recipe. Did you know that measuring spoons are not the same as those you eat with? Bakers measuring spoons are precisely graded in size from ¼ tsp to 1 tbsp. Similarly, measuring cups used for dry ingredients and liquids, are not the same as your tea cups or coffee mugs. They are standardized to measure amounts from ¼ cup to 1 cup.

Experienced bakers also use measurement equivalents to help in their work. For example, if a recipe calls for a "dash" of an ingredient, they measure about 3 drops (liquid) or about 1/8 tsp (dry). One-fourth cup is approximately equal to 4 tablespoons and one tablespoon is equal to three teaspoons.

As you become a more experienced baker, you may wish to experiment by adding some chocolate chips to peanut butter cookies, or some raisins into oatmeal cookies, along with some pecans instead of walnuts. Experimentation is fine, but a master baker will tell you that you are never too accomplished or experienced to measure ingredients with the appropriate tools.

Additional Resources

- https://www.ted.com/topics/math**.** There are many TED talks that focus on extensions to the examples discussed here: How to spot a misleading graph? Why you should love statistics? The math behind basketball's wildest moves.
- http://www.npr.org/sections/thesalt/2013/12/03/248347009/cookie-baking-chemistry-how-to-engineer-your-perfect-sweet-treat. This National Public Radio episode explores the chemistry behind baking cookies.
- http://www.historyworld.net/wrldhis/PlainTextHistories.asp?ParagraphID=cah. This website summarizes the key events that resulted in the definition of standard measures for temperature, time, volume, weight and length.