omni CALCULATOR

MAKING IT COUNT

A Journalist's Guide to Numbers

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01
INTRODUCTION

WHY WE BUILT THIS GUIDE

A governor of 150,000 taxpayers has been stealing public funds for 30 years, starting at $2 million and increasing by 1.5% each year.

QUESTIONS TO KEEP IN MIND

Among the first questions we should ask ourselves as journalists are:

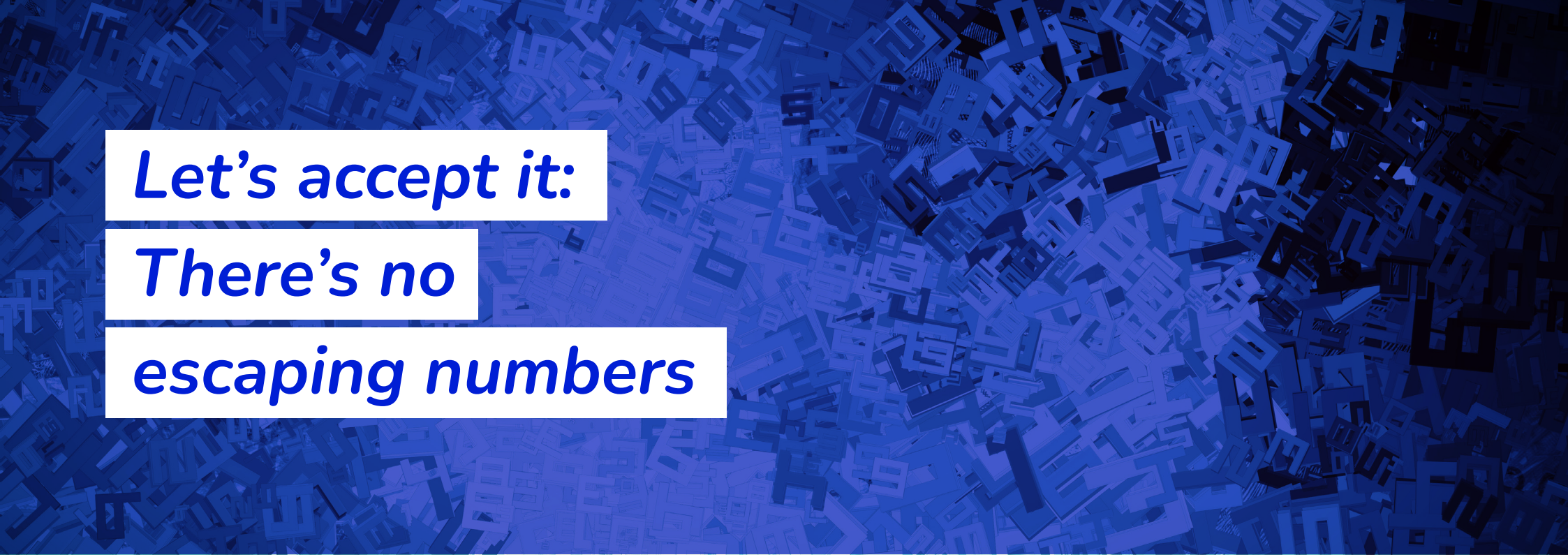
How much did the governor rake in last year?

How much in total over three decades?

How much did he pocket from each citizen?

And oh, will he be able to pay for the best legal defense in the country?

Imagine the nightmare if we can't do the math. It means we can't even tell our audience the mindboggling sums this local public official has plundered. It will certainly put us a long way off from reaching our aim *"to spread the light of truth to all the dark corners of the world."*



Let's accept it: There's no escaping numbers

At the turn of this century, 44% of news stories contained statistics.

Since then, the scope and size of data that journalists try to summarize has only increased.

Be it deciphering polling data to predicting the next premier, investigating the story behind public health data, or just reporting the best striker this season, **people seek numerical ways to understand the world** around them and guide their actions.

Therefore, if we are to serve our audience optimally and tell the full story, it is our duty to confront our innumeracy. *Means, percentages, conversions, margins of errors*—we must master all of these. This is especially true when it comes to issues of national or international concern.

It can be difficult for most people to grasp the scale of destruction wrought by a natural disaster or the scope of a nationwide corruption scandal.

By showing what these figures mean on the scale of the reader's community or salary, we can add emotional weight to our work and motivate people to act.

So, if a reader knows that his governor fleeced his neighborhood for $3,079,961 last year, $75,077,363 since he took office, and spent $500.51 of his hard-earned money on fast cars and expensive holidays, is he going to be happy?

An essential pillar of journalism is that we report facts. Numbers are by nature absolute—there can be no debate about the answer to 2 + 2. If we get our calculations wrong, misplace a decimal point, or use incomprehensible units, the results can be disastrous for the public. We may also lose our credibility.

We cannot, therefore, misrepresent the facts

Additionally, knowing how to interpret data properly allows us to notice when other people present data incorrectly. We've come across numerous instances when people cite expert studies without thoroughly understanding them or only present half of the story that suits their narrative. Journalists equipped with these analytic skills can help uncover the truth. More so with numbers.

"A number looks solid, factual, more trustworthy than a fallible human source," says Deborah Potter, former NewsLab executive director.

From headlines to hashtags, the issue is not then, "How do I escape numbers?" but...

"HOW DO I USE NUMBERS TO TELL AN HONEST STORY, EVEN THOUGH I AM NOT PARTICULARLY COMFORTABLE WITH THEM?"

Our aim with this guide is just that: To provide all journalists, *whether they're campus reporters or seasoned correspondents*, with tools, tricks, and tips that they can use to overcome numerical shortcomings they may have.

HOW TO USE THE GUIDE

CALCULOTTER TIP

omnicalculator.com

We'll also provide you with a range of tools from Omni Calculator, a trove of free, custom-built online calculators that can make your day easier.

Journalist's Calculators Collection

A collection of calculators to help you construct a compelling story.

MANY NEWSROOMS JUST DON'T HAVE THE TIME OR RESOURCES TO OFFER THEIR JOURNALISTS COURSES TO HELP THEM DEAL WITH NUMBERS.

That's why we came up with this guide.

This free, bite-size handbook gives an **overview of some essential mathematical topics** to use as a jumping-off point whenever you feel challenged by numbers.

LEARN HOW TO

- **Put numbers in context to ensure you get your message right.**
- **Interpret statistics to determine if there really is a story.**
- **Check your calculations so they're mistake-free.**

Over time, we hope that this guide will not just serve as a lifeline for the math-averse reporter but as a constant companion. Working with data is inevitable and essential in modern journalism in order to tell a complete story that helps our audience make sense of an ever-changing world.

02
REPORTING NUMBERS

CRAFTING YOUR MESSAGE

Think about it.

What are you more likely to believe: A story filled with **“many,” “more,”** or **“better”**? Or a story that cites hard numbers and sources?

USING NUMBERS IN NEWS MAKES NEWS MORE CREDIBLE.

Studies done over decades [1] [2] found this fact clearly reflected in how people perceive the trustworthiness of the media. And there’s no excuse we can’t provide the numbers because numbers are everywhere.

Correctly interpreting the data around your message makes it more reliable and impactful. **Refining numbers and creating a message the numbers support** is a fantastic skill and is virtually a requirement in modern journalism.

QUESTIONS TO KEEP IN MIND

First, consider **the goal of your data analysis**. This will influence which statistical tools you should apply.

Are there questions you hope to answer?

Maybe you want to know how certain age groups voted in a recent election.

Is there something you need to verify or disprove?

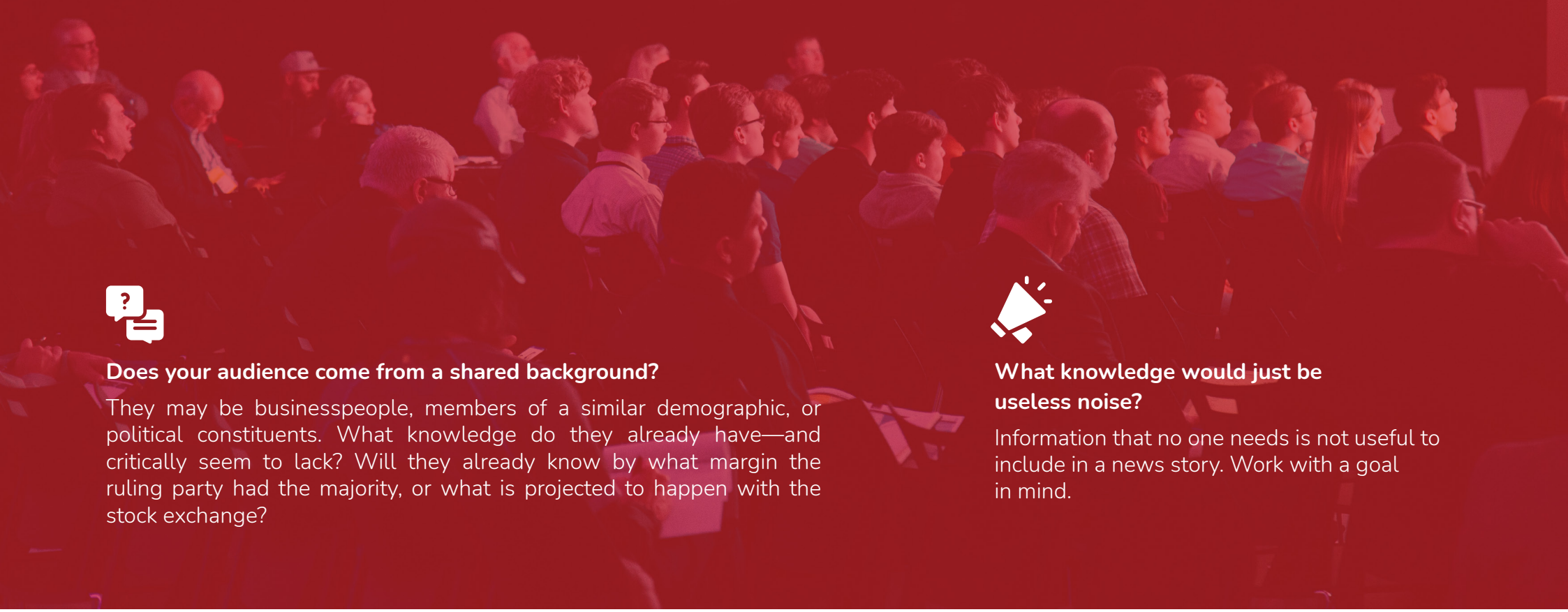
Perhaps you have to analyze data that disputes a recent claim by a politician.

What is the nature and complexity of the data at your disposal?

Is it financial or possibly highly technical? Is it something a layperson will understand?

This will influence which statistical tools you should apply.

All these questions should provide clues for what to do with the raw data in front of you.



Does your audience come from a shared background?

They may be businesspeople, members of a similar demographic, or political constituents. What knowledge do they already have—and critically seem to lack? Will they already know by what margin the ruling party had the majority, or what is projected to happen with the stock exchange?

What knowledge would just be useless noise?

Information that no one needs is not useful to include in a news story. Work with a goal in mind.

The number-crunching you perform should be influenced heavily by who will read, listen, or watch the final story.

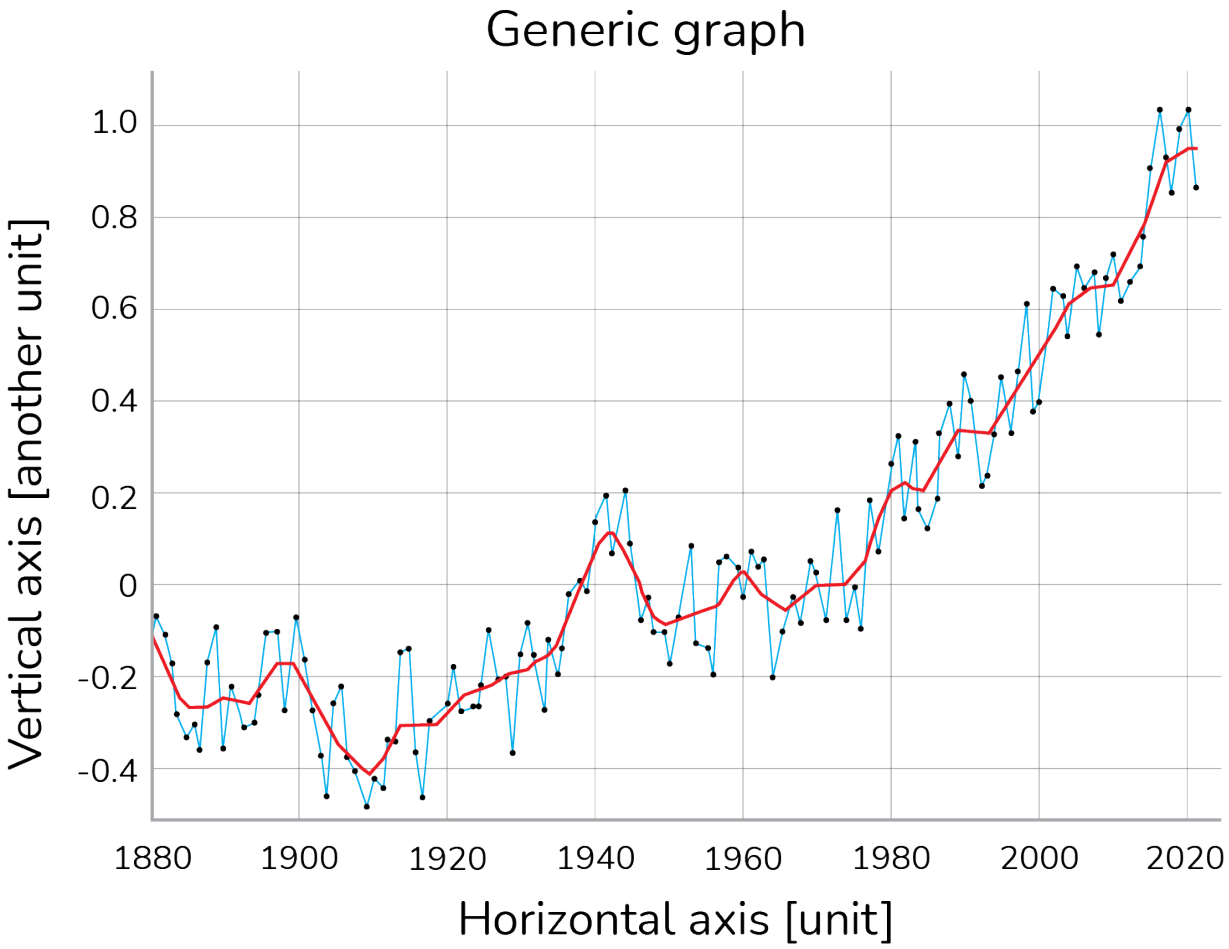
All these considerations will help you understand how your audience sees the world and how you can reach out to them effectively.

Decide **how to convey the information** you've discovered to your target audience. Based on these insights, you can choose whether and how to visualize your findings. Your choices of text, charts, tables, and infographics rely on what story you want to tell and to whom.

Be trustworthy. Reference your sources, back up your statements with the appropriate data, and use clear visuals that won't obscure the truth or muddy your message.

Determine the audience of your story

CONTEXTUALIZING NUMBERS

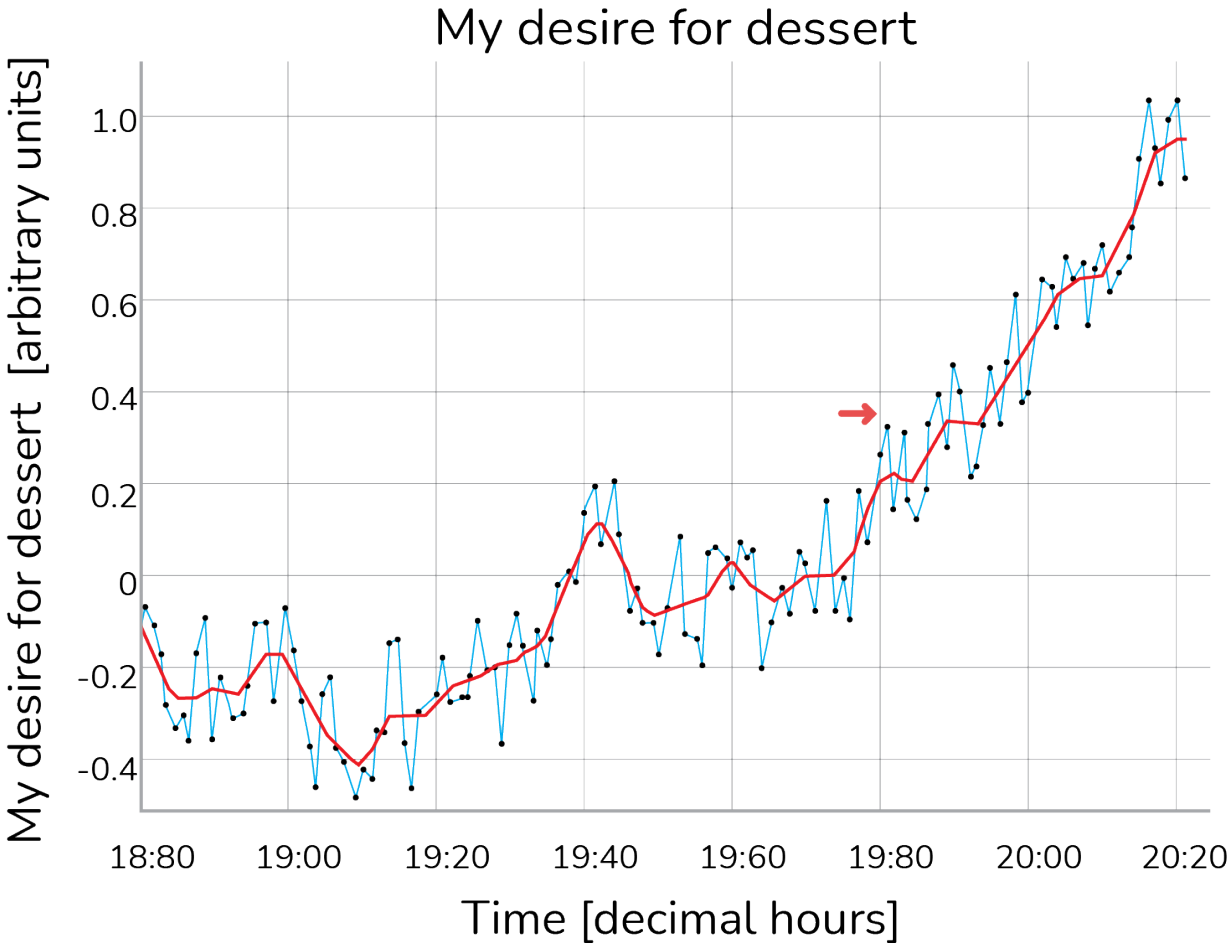


Numbers surround us: prices of goods, volume of rainfall, times in a marathon. But numbers alone are not enough to tell the full story.

Take a look at the graph to the left.

WHAT DOES IT TELL YOU? NOTHING!

There are no **labels**. What we have are **only numbers** on the vertical and horizontal axes, and their smoothed average. There is no context. We need to add labels or **units** so that the numbers can tell a story.



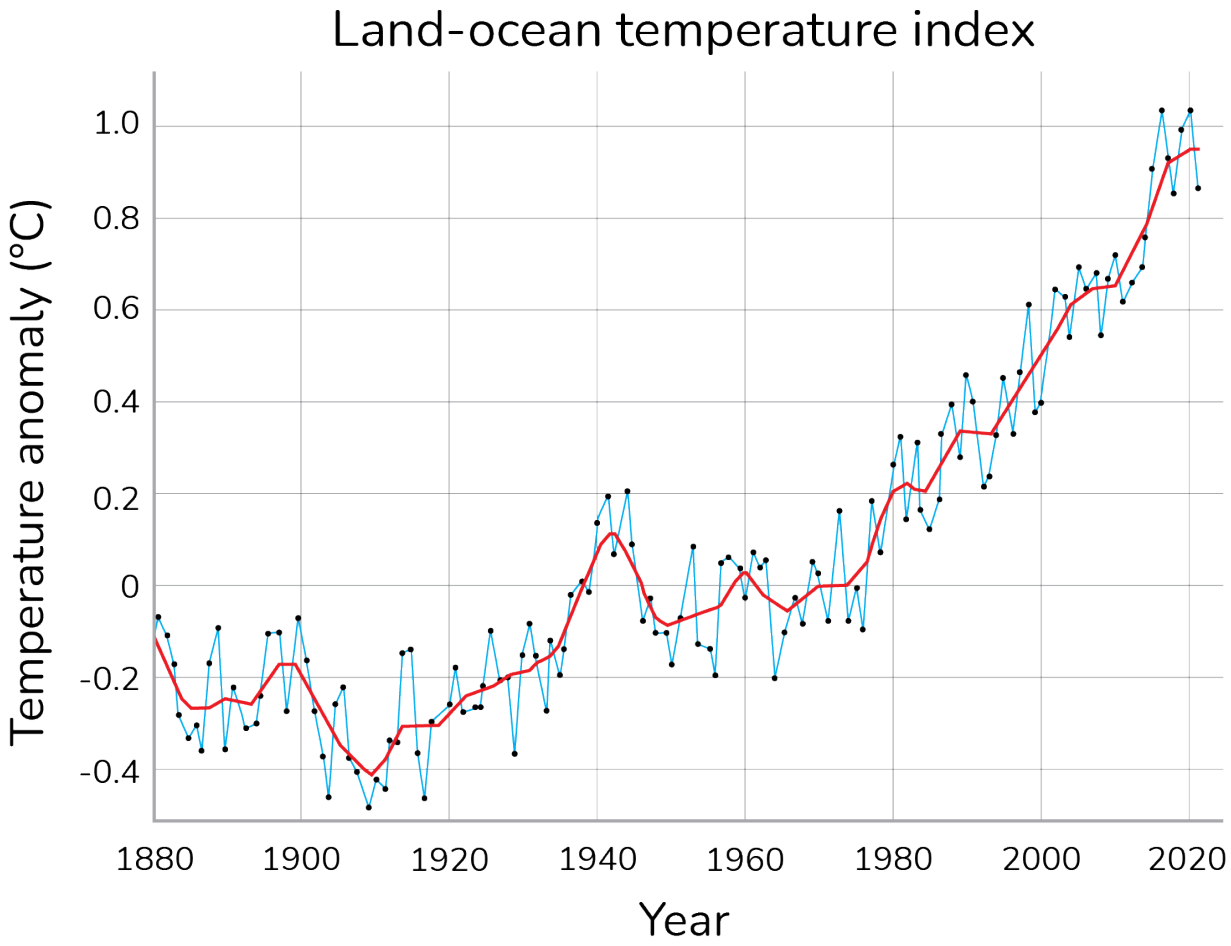
Look now at this graph.

Finally, some context... or maybe not? The analyzed after-dinner craving for dessert peaks at 8:20 p.m.

But who cares?

Is it worth reporting?

NUMBERS NOT ONLY NEED CONTEXT BUT NEED THE RIGHT CONTEXT.



LET'S MAKE OUR NUMBERS MEANINGFUL.

Here's yet another graph on the left.

As you can see, the graph represents the rise in temperature our planet experienced in the past 140 years. The worrying trend is perfectly represented by a concise yet significant graph. The numbers finally gave us the story; now it's the turn of the journalist to convey the message in the most significant way.

You can see three uses of the same dataset: first *without context*, then *without meaningfulness*, and lastly, *representing one of the most pressing issues that humanity is facing*.

When reporting, always be sure that you are conveying the correct message

Reporting on numbers requires giving them a proper context. Rarely do we deal with numbers alone (that's what arithmetic is for). More often, we need to consider the quantity measured by the numbers themselves. 60 is just a number, but 60 miles per hour is the speed limit on UK main roads, and 60 seconds is a minute. **Units always matter!**

Contextualization of a number is almost an art: Measurement units are arbitrary, as opposed to the quantity they measure. Length is length everywhere, but the length of a sheet of paper is about 30 cm for a European and about one foot for an American (0.91 ft, to be exact).

Using **precise figures** such as percentages also brings a story closer and closer to the truth, rather than vague references to numeracy like "many," "more," "few," or "less."

To tell a more complete story of the data, journalists would need not only basic statistical or numerical literacy but also **an appreciation of the methods and specifics behind a certain dataset or statistic.**

Take, for example, a story on opinion polling during elections. Headline percentages tell us the support a particular candidate has obtained at a certain point in time. But breaking down the data further—for instance, highlighting why a candidate leads in a certain area or why they are preferred when it comes to a particular issue—provides more depth to your story.

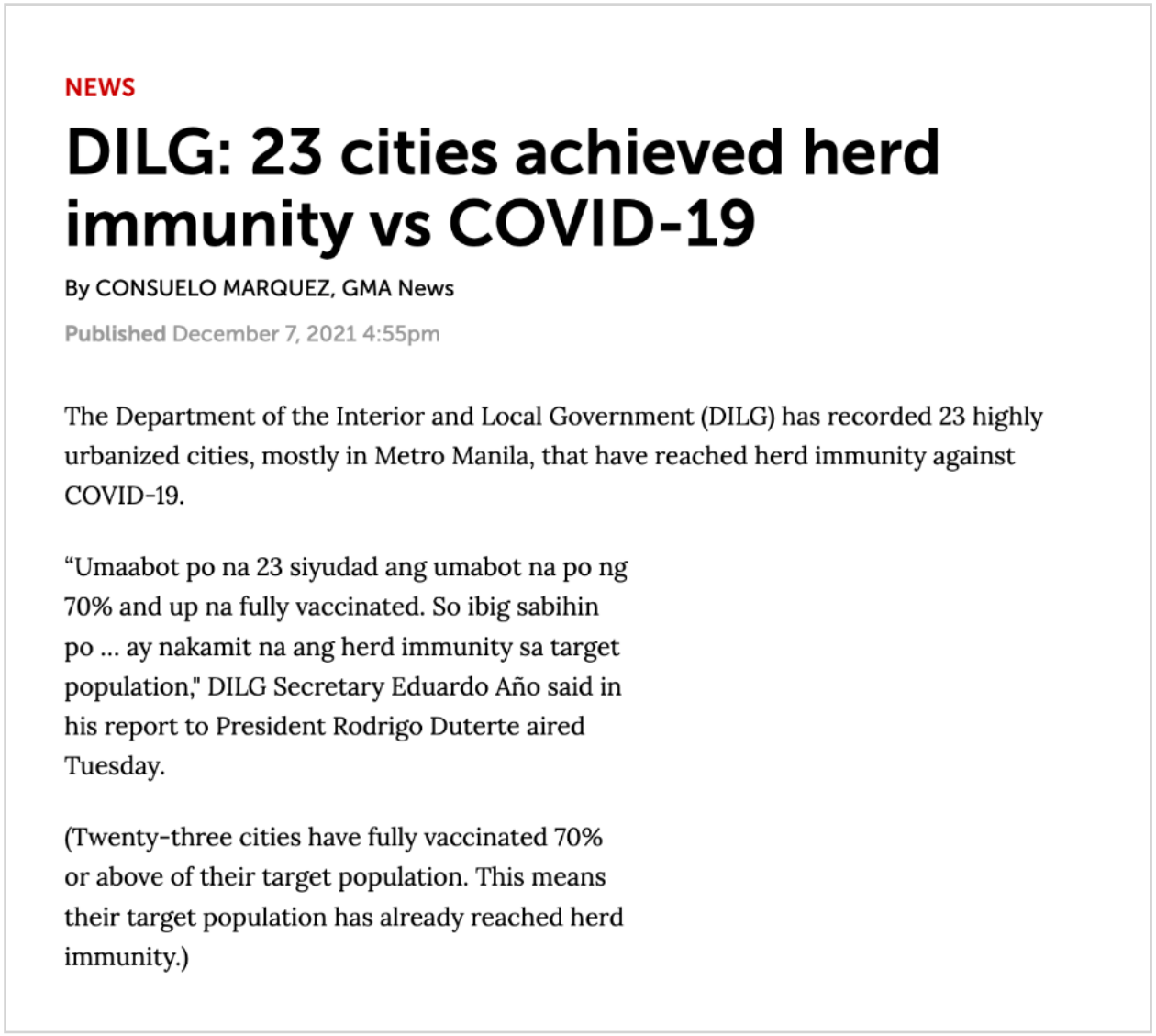
Look out for inconsistencies, limitations, and gaps in the data

Another possible story idea is to explain certain technical terms related to **how opinion polls are conducted**. Frequently asked concepts include the margin of error and the science behind random sampling. In this way, we can also help our audience understand why surveys are used to measure public opinion and what makes them "reliable."

An excellent example of this is publicly available data for **COVID-19 vaccination**. The data may be presented according to how the government or an institution defines its targets.

For instance, in the Philippines, government vaccination targets are typically measured against "70% of the population," defined by state agencies as having met the threshold of "herd immunity," or the threshold of the population with enough immunity to significantly slow the spread of the virus, rather than simply against the total population.

This can be potentially misleading for people who might think the figures are reported as the percentage of the whole population, which is a more straightforward way of presenting the data. This may also lend a false sense of security for those not too familiar with the complexities of achieving "herd immunity," which can be a moving target depending on the situation. Other important indicators, such as whether enough vulnerable people like seniors and persons with comorbidities have been vaccinated, may be "overlooked" by focusing solely on the "70%" goal.



NEWS

DILG: 23 cities achieved herd immunity vs COVID-19

By CONSUELO MARQUEZ, GMA News

Published December 7, 2021 4:55pm

The Department of the Interior and Local Government (DILG) has recorded 23 highly urbanized cities, mostly in Metro Manila, that have reached herd immunity against COVID-19.

"Umaabot po na 23 siyudad ang umabot na po ng 70% and up na fully vaccinated. So ibig sabihin po ... ay nakamit na ang herd immunity sa target population," DILG Secretary Eduardo Año said in his report to President Rodrigo Duterte aired Tuesday.

(Twenty-three cities have fully vaccinated 70% or above of their target population. This means their target population has already reached herd immunity.)

To address this, you can make your own computations using the tools listed in this guide (spreadsheet programs like Excel will be especially valuable) and based on the latest population data. Make sure to **cite your data sources** so that your audience can check them out for themselves.

> **IN YOUR STORY, EXPLAIN AND CONTEXTUALIZE THE OFFICIAL FIGURES AND THEIR IMPLICATIONS.**

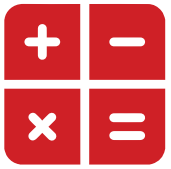
Figure 1. A Philippine news article reports a declaration from a government agency that several cities have reached "herd immunity." While the government has set "herd immunity" at "70% of the population," medical experts and epidemiologists have noted that coming up with an exact percentage can be quite "tricky," depending on several factors

A similar example is the challenge of obtaining consistent data on COVID-19 from different states in the United States. The COVID Tracking Project noted three major challenges in gathering and publishing data that would provide a nationwide summary: how data was defined, made available, and presented.

Figure 2. A report by The COVID Tracking Project shows the reporting inconsistencies across the different states of the US.

DON'T FORGET TO MENTION...

WHERE YOU GOT THE DATA



WHAT COMPUTATIONS YOU DID

WHY YOU INCLUDED THEM IN YOUR STORY

Another possible story is to explain why the government might present data in a particular way and the possible advantages and disadvantages of doing so in terms of personal and public health decisions.

When dealing with topics such as healthcare, education, medicine, and other subjects that impact a person's day-to-day life, it is crucial to demonstrate numbers in a way that informs and educates the audience on how the news affects them. This will **assist the audience in making decisions.**

For example, if told that a degree costs $99,417 on average in the US, it might help readers make an informed decision about whether sending their kids to college is worthwhile.

Another example would be an economic story in which the price of gasoline in the US is projected to increase to $4.27 per gallon by the end of the year. This information will assist readers in accurately managing their day-to-day finances when that time comes.

Make connections and utilize logic

Just as there are numbers in every story, there are also stories that lie in numbers. When researching, it is important to read between the lines and identify connections—if any—that present a bigger story.

For example, an open source data expert noticed something unusual in the traffic data on Google Maps occurring along the Russian-Ukrainian border. Soon afterward, the news broke that Russia had invaded Ukraine.

So the story was already in the data, waiting for someone to find and interpret it.

IN TODAY'S VAST QUANTITIES OF DATA, THERE ARE UNDOUBTEDLY OTHER STORIES HIDING IN PLAIN SIGHT.

Is the story newsworthy enough?

Journalists typically produce data and stories by relying on topline statistics from press releases provided by government agencies, the private sector, survey firms, and non-government organizations. While this is standard practice given tight deadlines, the same journalistic **"nose for news" and skepticism** are needed to sift through and dig deeper into numbers and data.

We asked **Prinz Magtulis**, a financial and data journalist taking his MS in Data Journalism at Columbia University, for some tips on how to determine if a particular statistic is newsworthy or not.

QUESTIONS TO KEEP IN MIND

Does the data point mark a significant milestone?

Is it a record high or a record low?

If it does not mark either a record high or low, what is the trend of the data?

Are you seeing a decrease, increase, or is it the same? Does the statistic represent a break in the trend?

So what?

That's perhaps the most crucial thing to ask. What are the data's implications for government officials who make and implement policy? For decision-makers in companies and institutions? For ordinary citizens going about their daily lives?

Magtulis also cautions against trusting all the numbers that you read.

> **"YOU OFTEN HEAR JOURNALISTS SAY, NUMBERS DON'T LIE, BUT ACTUALLY THEY LIE, THEY LIE A LOT OF TIMES," HE SAYS.**

One example is in reporting employment statistics. If the headline unemployment rate does not indicate record figures, then what does the trend indicate? Are more people unemployed than last year, or when compared with other neighboring countries? Does the trend represent typical seasonal labor trends (for instance, an increase in employment as the holiday season nears)?

Go beyond what is often highlighted

For instance, when government leaders highlight figures showing how they have created more jobs than any other administration, make sure to check and verify their baseline data. Then contextualize and dig deeper: Did the country just emerge from a major economic crisis that laid off a record number of workers? What kinds of jobs are people employed in? Are these secure, well-paying jobs or precarious, low-wage gigs?

Again, journalists should remember to always take their audience into account when determining what's newsworthy. Communicating news with numbers should result in the **audience gaining new knowledge from your story.**

Ask yourself: What is the main takeaway from these numbers? What are the key points that need to be highlighted? Cohesion is vital in telling the story and connecting with your audience.

In order to present numbers in a way that will make the most sense to the audience, it is imperative to know their:

- ✔ **Level of comprehension**
- ✔ **Natural facility with numbers**
- ✔ **Attention spans**

If the reader has to reread the main sentence of the news story more than three times before fully understanding what it means, then the reporting could be falling short.

Use numbers strategically and only when needed

While incorporating figures, percentages, and statistics offers a story more credibility, it is also essential not to drown out the main points of a story with numbers. If every other sentence highlights and contains numbers, it may become challenging for the audience to grasp the salient takeaways of a story.

For example, when reporting the hesitancy surrounding the vaccine—CNN Life framed the 32% of Filipinos who were willing to receive the vaccine more simply: *"Roughly only 3 out of 10 Filipinos are willing to be vaccinated."*

In addition, back in 2021, news sites reported that 1-2% of those infected with COVID-19 can die, which may frame the infectious disease as low-risk but that 1-2% at the time was equivalent to 4 million—which is the population of almost 73 Philippine Arenas.

COMMON CALCULATIONS FOR JOURNALISTS

Data is getting bigger in every sense of the word. Forbes found that 90% of the data that existed in 2018 was generated in the previous two years. What's more, this data is coming from all kinds of sources in various sizes and formats. Knowing **how to explore, understand, and interpret the vast amounts of data** at our disposal is a **critical skill** in modern times—especially for **journalists.**

I. AVERAGES

Given a dataset, what's the "typical" value? Is it the one that's precisely between the highest and lowest values? Is it the value that occurs most frequently? Does a value even have to appear in the dataset to be considered typical of that dataset?

The answer is that there is no one correct way of finding the "typical" value because it depends on what is considered "typical" of the data's type and what you'll do with the typical value later. Nevertheless, the hunt for this mythical typical value is universal. And what we're hunting for is the dataset's **central tendency**—one value that is considered central to (or typical of) a dataset. In everyday conversation, it's more commonly called the "average" of the dataset.

As we saw above, it can be hard to define "typical," and so there are many **different measures** of central tendency: the *mean*, *median*, and *mode*.

MEAN

The sum of the values divided by the number of values. It's affected by each of them equally. It can also be affected by unusually large/small values, and if there are enough unusual values, the mean becomes less useful to us.

MEDIAN

The value in the middle of the series when it's in ascending order. It's more robust to extreme values because the middle of the dataset is generally surrounded by similar values. No matter the data's values, you can always know that exactly half of the dataset's values are lower than the median and the other half higher.

MODE

The value that occurs most often in the dataset and is the majority. It's not affected by a few extreme values. This is especially useful with categorical data, where values aren't numerical or even ordinal—like political parties, cities, races, or sports teams. But it's also hard to draw conclusions on the data based on just the mode.

CALCULOTTER TIP

Mean Calculator

Median Calculator

Mode Calculator

Find your preferred measure of central tendency with ease using one of these tools.

Which measure of central tendency we'd use depends on the context of the dataset and what we know about the data on a qualitative level.

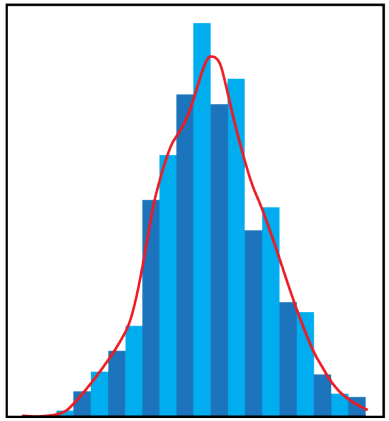
- If we're trying to find the average salary of a certain profession, we'd likely use the **mean**, as we'd expect to see comparable values—they're all doing the same job, right? However...
- Suppose we're looking for the average salary of an entire country's population. In that case, we might prefer the **median**, as there will be extremities in the data (like the 1% of a country who are CEOs) which might make the mean less meaningful.
- We'd use the **mean** to determine the average age of voters in an election, but...
- We'd use the **mode** of voters' ballots to segment different demographics to analyze how they voted (and, of course, to determine the election's outcome).

II. DISPERSION

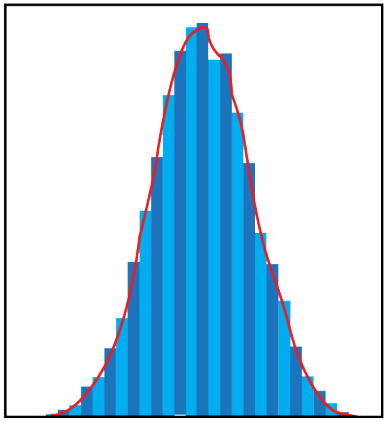
Another fundamental quality of a dataset is its dispersion (aka its spread or variability)—simply meaning how far spread out the data points are from the mean. Dispersion itself can be seen as the average distance of a data point from the mean (although its mathematical formula is more complex).

The most popular measure of dispersion is the **standard deviation (SD)**. Larger standard deviations mean that the data is further spread out (and varies more) than a dataset with a small standard deviation. A large or small standard deviation is not inherently good or bad—that depends entirely on the data's context.

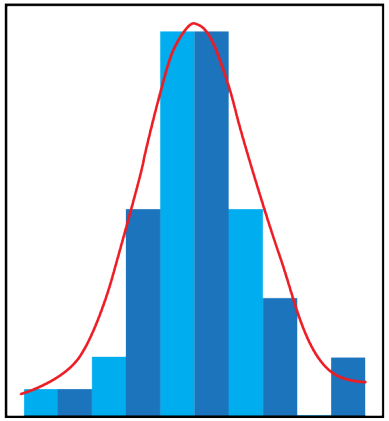
2021's SAT scores



10,000 rolls of six dice



Petal lengths of 50 setosa flowers



Putting it all together: Normally distributed data

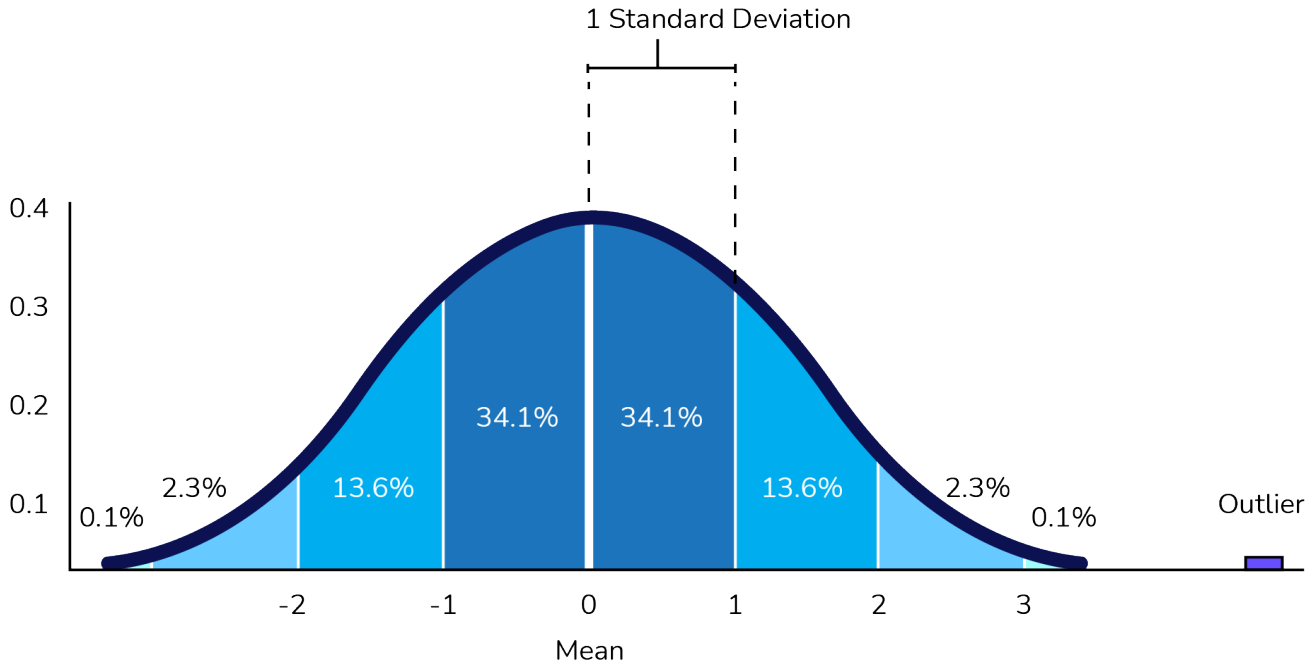
Most real-life data is arranged according to the **normal distribution**, which has a **mean** (or "center") and a **standard deviation** (or "width"). The normal distribution is everywhere: exam scores, hospital patients' blood pressures, the sums of rolling multiple dice, shoe sizes, flower petal lengths, and stock prices—they all follow the famous **bell curve** (at least roughly). Knowing this, you can make interesting conclusions and predictions on a dataset just by looking at the mean and the standard deviation!

CALCULOTTER TIP

Standard Deviation Calculator

Normal Distribution Calculator

Use these tools to help you with dispersion!



For example, we can make some interesting predictions with real-life data:

- **68%** of a dataset's values are closer than one standard deviation from its mean;
- **95%** of a dataset's values are closer than two standard deviations from its mean; and
- **99%** of a dataset's values are closer than three standard deviations from its mean.

And what about the 1% of data points that are further than three standard deviations from the mean?

We call those **outliers**.

III. OUTLIERS

Sometimes, data points are vastly different from their peers. We call such a value an **outlier**. A common way to find them is to look beyond three standard deviations from the mean. However, what exactly constitutes an outlier depends on the context of the data.

- A person of the ripe age of 100 is an outlier because they're 15 years or more older than most living senior citizens. Their age is **significantly greater** than most of the population.
- However, if your colleague earned just $15 more than you did annually, you wouldn't really care because your salary is **insignificantly lower**. Their salary is not an outlier.

A dataset's outliers can affect its mean, making it a less reliable indicator.

No matter where or how you found them, **outliers are interesting**. They have a reason for being unusual, and thus they have a story to tell. Who knows? Perhaps an outlier could be your next big story.

CALCULOTTER TIP

Outlier Calculator

Need to visualize the outliers? This calculator shows you a graph of your data!

Consider the annual salaries of 550 basketball players in the 2017-2018 NBA season:

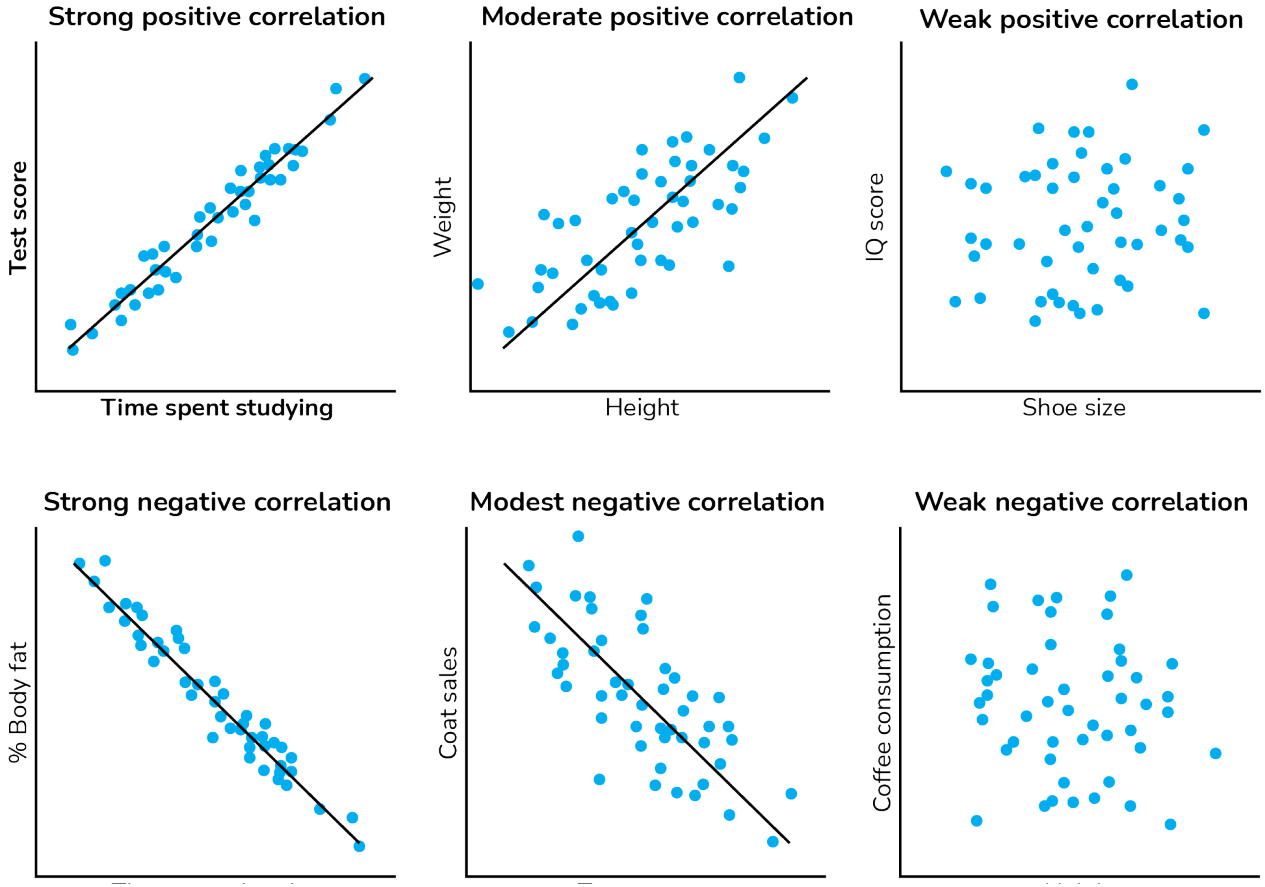
The mean salary is $6 million a year, and the standard deviation around that mean is $7 million. If we remove the top-scoring 20 players (whose annual salaries exceed $27 million a year), such as Stephen Curry and LeBron James, the mean drops to $5.5 million a year. That's a remarkable shift of $500,000 for the small price of dropping 3.6% of the data points.

(As an aside, the median salary only went from $2.5 million to $2.4 million, which proves the median's robustness to outliers.)

IV. CORRELATION

When you have multivariate data (grouped quantities, like a table of 100 people's ages, heights, and weights), things can get really interesting. To find meaning in such data, we can look for the **correlation** between variables. If two variables correlate, they increase and decrease together. Stronger degrees of correlation mean that there's a stronger relationship and, thus, the two variables increase and decrease together more proportionally and more often.

For example, we expect to see umbrella sales increasing on days with rainfall, and more umbrellas should be sold on days with rainstorms than on days with light drizzling.



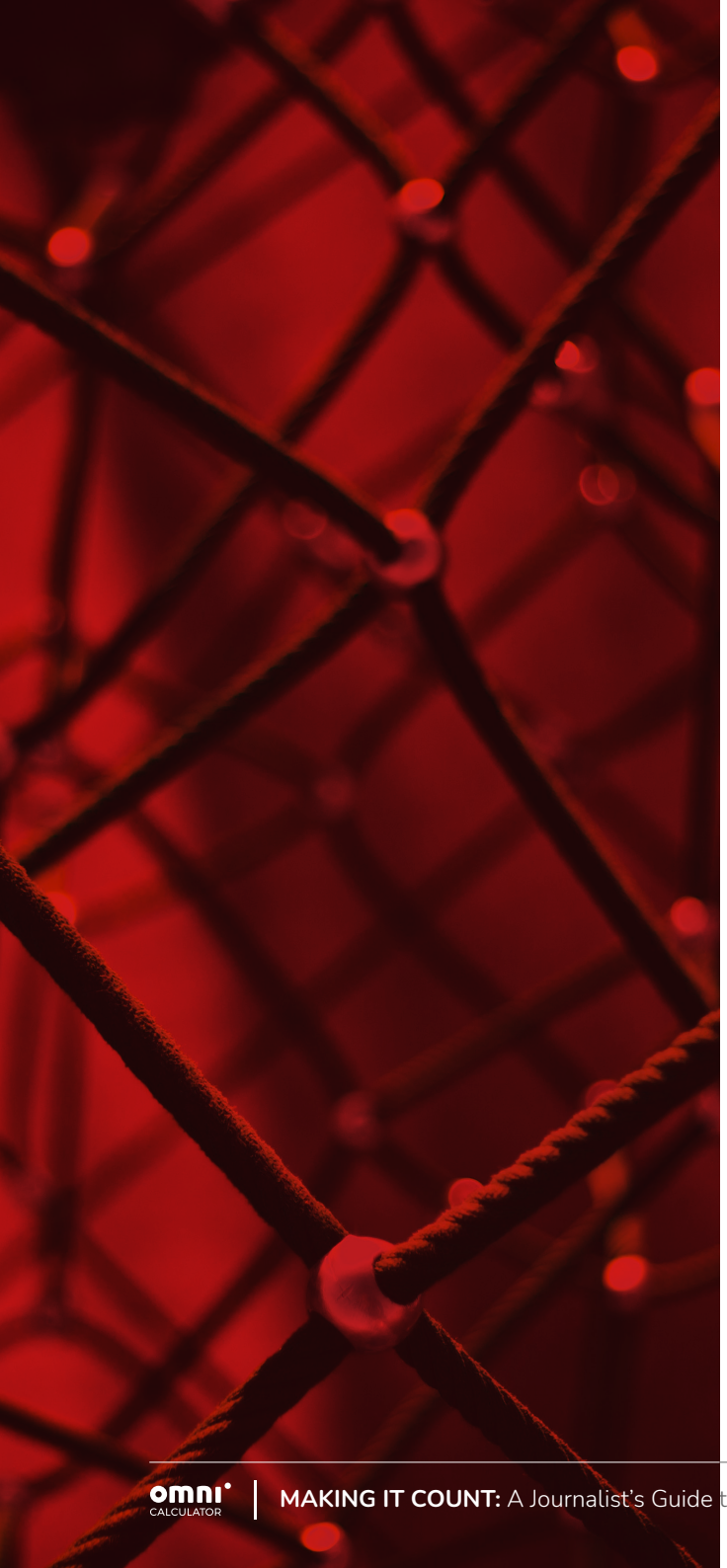
Take a look at these scatter plots. The points in the leftmost graphs are closer to falling on a straight line than in the graphs on the right. And that's to be expected if we look at the axis labels to learn what the graphs represent.

Spending more time studying means you'll do better in your tests.

Having bigger feet has no bearing on your IQ score.

Spending more time jogging means you'll weigh less.

Being taller has no influence on how much coffee you drink.



A high degree of correlation implies that there is a strong relationship wherein one of the variables directly influences the other—but it could mean that there is a third variable affecting the first two. And the tricky part is that sometimes, this third variable isn't being measured, and is hidden.

AS THE FAMOUS SAYING GOES, "CORRELATION DOES NOT IMPLY CAUSATION."

Just because two variables increase or decrease together, one's change didn't necessarily cause the other's change. Hidden variables pose an intellectual hazard to those trying to make sense of data and can lead to dangerous and ridiculous conclusions.

On days when more ice cream is sold at the beach, more people tragically drown. *Does eating ice cream cause people to drown then?* No. If we take a step back to look at the big picture, we'd realize that warmer days bring more people to the beach, which drives up both ice cream sales and water incident numbers.

Poor neighborhoods generally have higher pollution rates. *Does this mean that poor people cause more pollution*—or that polluted districts are cheaper to live in and are perhaps the only place some can afford?

V. PERCENTAGES

A tricky mathematical pitfall is **percentages**.

To find the **percentage**, let's say how much is 5 out of 30 in percent, simply **divide** the value by the "reference", then **multiply by 100**.

$$\frac{5}{30} = 0.167 \rightarrow 0.167 \times 100 = 16.7\%$$

MISSING AN IMPORTANT STEP

A journalist wanted to demonstrate the Philippines had become a low-risk area for COVID-19 infections by comparing the number of active cases to the total reported infections. He keyed in the numerator and denominator in the calculator app on his mobile phone.

The problem was, he took the resulting number (0.008) and added a percent symbol after it, forgetting the crucial step of multiplying the figure by 100 to get the proper percentage share (0.8%). As a result, he unintentionally downplayed local COVID-19 infections versus reality.

Percentages aren't that straightforward. **The error here was treating the symbol "%" just as a symbol. It's not!** "%" is somewhere between a unit and a constant with a value of 0.01. If you see 25%, you can think of it as 0.25. The correct answer to the problem is that 0.008 = 0.8 × 0.01 = 0.8%.

CALCULOTTER TIP

Percentage Calculators

Here's a collection of tools that can help you with calculating for the percentages.

CALCULOTTER TIP

Percentage Change

Use this calculator to help determine the percent change between two values.

Percentage Increase

Percentage Decrease

If you need to calculate the amount of increase or decrease, try these tools.

Perhaps the most common calculation that journalists across all news beats use is tracking percent changes—whether it's a politician's survey numbers or corporate budgets. They say two numbers make a story, so there's no excuse to commit a mistake in comparing the percent increase or decrease relative to the base number.

To find the **percentage change**, let's say how much it changed from 15 to 40, **subtract the initial value from the final value**, then **divide the result by the initial value:**

$$40 - 15 = 25 \rightarrow \frac{25}{15} = 1.67 \rightarrow 1.67 \times 100 = 167\%$$

Don't be scared by increments of more than 100%, and remember that an increase to **twice the original quantity** corresponds to a 100% increase. And a threefold increase corresponds to a 200% increase and so on.

Be sure that you are distinguishing between **percentage points** and **percentage changes**: The former are **differences between percentages** while the latter are **fractions of values**. Here's an example: from 56% to 45%, there are 11 percentage points difference, but a -19.6% decline (percentage change).

COMPARING PERCENTAGE INCREASE/DECREASE

Donna was writing about inflation and wanted to **illustrate just how much prices of essential goods had moved from a year ago**. Since she was unsure of her math, she simply deducted the current price from the cost a year ago. This made her data presentation weak as she could not establish a trend (since the price movements per peso varied across items). An editor asked her to revise her copy, but the math threw her off.

An absolute decrement/increment varies in magnitude depending on the reference values, while the ratio of the initial and final value can be the same. What Donna did here is a common mistake: Instead of computing a ratio (and from there, without effort, a percentage change), she calculated the absolute difference. How could she find the mistake before submitting the copy? Maybe by checking the units: The calculated difference is measured in **pesos per item**, while the percentage change is **dimensionless**. This is why we can compare inflation **rates** across items, sectors, and even different currencies!

Take the recent climb of gas prices due to various world events. We will consider the prices of unleaded gasoline in June 2021 and June 2022. Though the prices are on the rise since the end of the first wave of the coronavirus pandemic, the war in Ukraine gave a shock to the market, reducing supply and allowing companies to set even higher prices.

In the US, the price changed from $3.13 to $5.15, for an increase of:

$$\$5.15 - \$3.13 = \$2.02$$

In Norway, in the same period, the price went up from kr16.72 to kr26.45:

$$kr26.45 - kr16.72 = kr9.73$$

The increases, in this form, are not comparable. If our reporter wrote “prices of gas increased by 9.73” in a US newspaper, mass panic would spread like wildfire.

Let’s compare the ratios:

$$\frac{\$5.15}{\$3.13} = 1.65 \qquad \frac{kr26.45}{kr16.72} = 1.58$$

As you can see, no more units, since we are dealing with ratios, and a comparable increase as Donna wanted to show.

DON'T SIMPLY REPORT ABSOLUTE FIGURES

A local government unit would sometimes only report absolute figures for the number of people testing positive for COVID-19, without mentioning the total number of people tested. This can obscure the full picture of the pandemic in the area.

So, for example, if the local government announced that 5 people tested positive yet only 10 people were tested, it might appear that COVID-19 cases are low. In fact, given this example, the percentage of positive people is 50% (compare this with the World Health Organization's threshold of concern of ≥5% positivity indicating a high level of transmission).

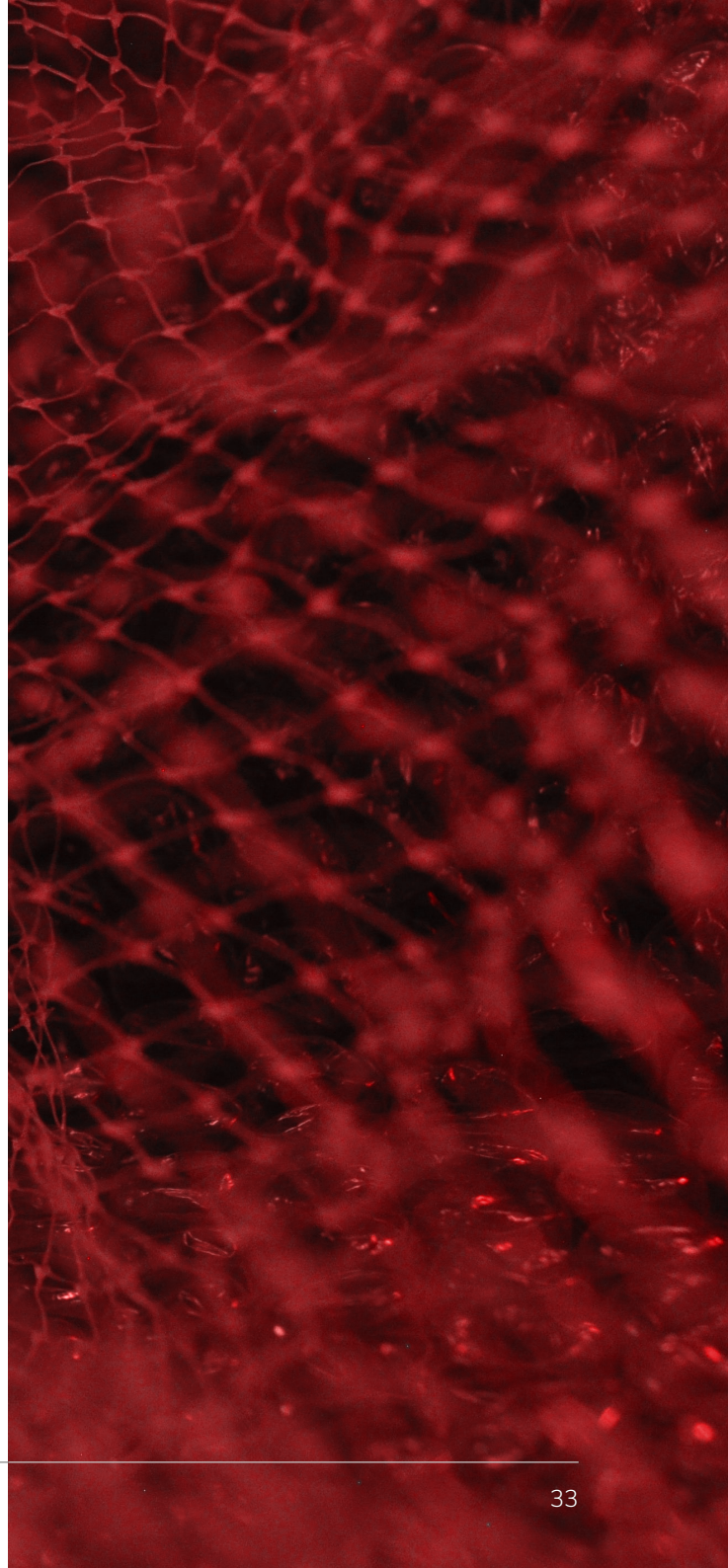
VI. RATIOS AND RATES

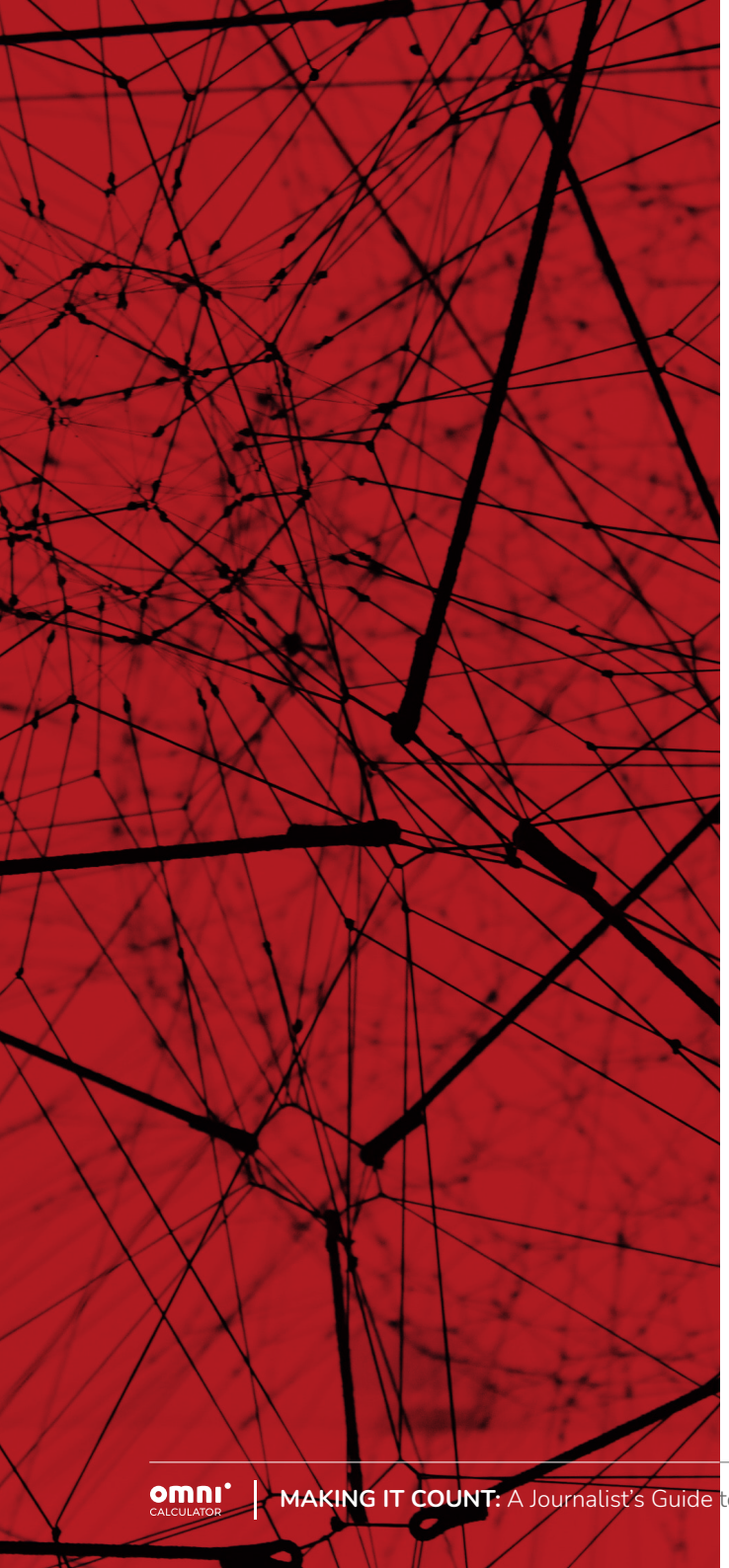
Ratios and rates are closely related concepts, with similar usages but capable of conveying vastly different messages. Both quantities **compare** two numbers, but in the case of rates, the measurement units of the two values are different. Let's see them in detail.

RATIOS

The ratio between two quantities is the result of their division, with the condition that both values have the same measurement units. As a consequence, ratios are **dimensionless**, and express **how many times** one of the quantities is contained in the other.

A good example of a ratio (one we know you have familiarity with) involves the size of the screen you are reading this guide on. If you are working on a MacBook, you are likely using a screen with **aspect ratio** of 16:10 or 16:9 (depending on the year). What does it mean, and how we calculate it?





Take the number of pixels on both sides of the screen: let's say 2,560 and 1,600. Divide the first number by the second:

$$\text{ratio} = \frac{2560}{1600} = 1.6$$

This ratio tells us that the screen is 1.6 times wider than it is high. And if you multiply by 10, you find 16: we've met this number just a few lines before.

This finding introduces us to the ways you can use to express the ratio of the quantity A to the quantity B:

- As a **number**: In this case, simply state that the ratio is equal to $\frac{A}{B}$;
- As a **fraction**: in certain cases the result of the division is not as significant as the fractional representation; and
- Using a **colon**: the ratio of A to B is equal to A:B.

For our screen, we can then express the shape of the screen as:

- The number 1.6;
- The fraction $\frac{16}{10}$; or
- The expression 16:10 (or equivalently 1.6:1).

You can decide if you want to reduce or not the ratio to have one of the members equal to 1.

Ratios are extremely helpful when you want to give a quick and intuitive idea of the relationship between two quantities, but you have to be careful when using them. **Ratios are ideal for comparing similar quantities in different contexts**. In finance, ratios are fundamental, and a good understanding of their use will make your reporting clearer and better understandable.

CALCULOTTER TIP

Ratio Calculator

Check out this handy tool for ratios. Don't forget to set the option to "simplify a ratio"

A police reporter wanted to analyze the crime rate across Metro Manila and gathered data from the Philippine National Police (PNP). He wished to add context by **adding details on the police-to-people ratio**, or the number of residents assigned to one police officer, in an attempt to visualize the data.

Based on PNP data, there were 21,881 members of the National Capital Region Police Office as of July 2021 against a population of 14.79 million, translating to a ratio of 1 cop per 676 residents. PNP's target was 1:500.

Instead of using the regional population, the journalist **mistakenly used the national population of 112.4 million as his numerator**. He ended up with one policeman for every 5,100 Filipinos, painting a gloomy picture as far as peace and order are concerned. It was published. A concerned reader reached out to point out the error. The media company responded by correcting the online article and publishing an erratum. Since the incident, the journalist has asked a colleague to check his computations before submitting a piece for editing.

Division is the less intuitive operation of the four "basic" ones: when calculating a ratio, always remember to check your data and to use them in the **correct order**. In the example above, our journalist could have calculated both the police-to-people ratio and the people-to-police one: the first one has a (correct) value of 676 citizens per officer. In contrast, the other has a value of 0.0015 officers per citizen. Which one is more meaningful and easy to grasp?

Using the correct base number, or reference value, is crucial when computing ratios. When comparing a part to the whole—say, how much you ate from one whole pizza—you take the number of slices you consumed (say, three) as the numerator and the total number of slices of pizza (say, 12) as the denominator. That's one-fourth, which is not too bad at all.

But getting the denominator wrong would paint a different picture. If you wrongly compare it to the number of remaining slices (nine), it would suggest you are closer to being a glutton.

A measure of the economical status of a country is the debt-to-GDP ratio. As the name says, it's nothing but the ratio between these two quantities. Philippine's debt-to-GDP ratio is (as of June 2022), 0.621. We could express this quantity in other ways, but a number is the best one this time. A single number is not that significant in other situations: reporting poverty numbers sound straightforward if it is stated as: *"23.7 percent of Filipinos are poor"*; however, it's hard to wrap one's head around it and visualize how widespread this is. But if phrased as *"1 out of 4 Filipinos lives in poverty,"* you will find it is easier to grasp.

RATES

Rates are the same as ratios, but the quantities involved have different units. Rates always have proper **measurement units**. Maybe you are not aware of this, but you use rates all the time: When you say "100 km per hour," you are implicitly calculating the ratio between distance (100 km) and time (1 hour).

Useful rates in reporting usually involve certain classes of a population compared to the total population (or a significant number of them). Think of the **birth rate** or the **unemployment rate**.

Rates are often calculated over time: A special mention goes to the **inflation rate**, which measures the **percentage change** of a financial index related to price over a **year**.

Ratios and rates are often used interchangeably, and from time to time, some units may look different but are the same: Are "students" and "teachers" different measurement units, or "people"? Before deciding, check which one of the two is the most widely used.

FINDING THE BASE

Here's a quarterly conundrum for many business reporters: Listed companies have to publicly disclose their financial records every three months as required by regulators. The rule of thumb is to lead off a story with the company's net income. But some firms are often one step ahead: They deliberately do not include the comparative year-ago or quarter-ago financial figures so that a profit decline or reversal to a loss will not be apparent.

Enterprising journalists should know better. Since they are listed companies, one can easily look for the report from the previous period online.

VII. CONVERSIONS

Switching from one measurement unit to another is an exceedingly delicate step. Errors may happen and slip unnoticed: We may use the wrong conversion factor, miss some orders of magnitude, or even make mistakes on the quantity we are measuring.

Journalists reporting on numbers should be extremely careful with conversions. As the Internet never forgets, there are traces of a conversion error in a BBC article on the Paris climate deal: The notoriously tricky conversion between Celsius and Fahrenheit was first correct (a **difference in temperature** of 2 °C equals a difference of 3.6 °F) just to be assumed wrong (or out of context since a **temperature** of 2 °C equals 35.6 °F).

Which are the most common conversions (and the ones we get wrong more often)? Probably the ones between the **metric** and **imperial** units systems.

> **AS LONG AS THE UNITS ARE CORRECT, UNDERSTANDABLE, AND FIT THE CONTEXT, YOU CAN USE WHATEVER YOU WANT.**

The weird units converter is both a fun and insightful tool: It often happens that a well-known unit lacks the significance of an uncommon but well-suited and **impactful** unit.

Would you be impressed if we said that the GDP of New Zealand is 210 billion dollars?

Let's try again: Would you be impressed if we told you the GDP of New Zealand is equal to Elon Musk's net worth?

CALCULOTTER TIP

Conversion Tools

Here's a collection of tools that can make conversion easier.

I linked some common conversions below for you!

Speed

Length

Temperature

Weight

For some unusual and entertaining units, check out this one:

Weird Units Converter

CALCULOTTER TIP

Time Zone Calculator

Convert between different time zones using this handy tool.

Reporters, especially international reporters or those on overseas assignments, sometimes have a hard time **converting time zones**, particularly when there is a significant time difference. This is further complicated if an area implements local rules, such as daylight savings time, which the reporter is unfamiliar with.

For example, if an event takes place in New York, USA, at 7 p.m. on July 11, a reporter working for a Philippine news organization has to correctly state in the story that the event happened the morning of July 12, Manila time.

CURRENCY CONVERSION

One lifestyle writer accidentally made a baby bassinet from a luxury furniture designer three place values (1,000 times) more expensive when she used a dot rather than a comma for a price in euros. In this case, dots or periods were used to separate three digits of whole numbers and a comma to distinguish decimals.

Currency conversions can be tricky, especially when there is a considerable gap in the foreign exchange rates. Computing into the millions, billions, and trillions can get intimidating. It's easy to underestimate or overestimate international loan amounts, for one, as well as national debt figures.

Notations also vary across the world. Decimal and thousand separators vary across countries and even sectors. The anecdote here shows us how complicated this topic can be: *"Europeans use dots or periods"* is a partial truth; Italian students use apostrophes to separate thousands! There are no solutions here: **Always check your target audience before writing down the numbers**. If you are not sure, skip the thousand separator and you'll remove half of the problem!

CONTEXTUALIZING WITH RELATABLE ITEMS

A reporter was writing about a government order limiting the size of a local fish species called "suno" that could be caught to 32-47.5 cm.

What could make readers better imagine the size? The reporter eventually came up with two surgical masks and not more than three venti Starbucks cups!

DIFFERENT NUMBERING SYSTEMS

Have you ever heard of lakhs and crores? Unless you're one of the nearly 1.8 billion individuals living in the Indian subcontinent (or are used to writing about Indian topics), chances are, these words are Greek to you. It certainly was for Izzy when she was a new reporter covering India and its economy.

Upon further reading, Izzy found out that crore and lakh both belong to the Indian place value system of numbering and are used to measure large sums, usually when referring to currency.

Simply put, a lakh is 1,00,000 or one hundred thousand (written as 100,000 outside India), while a crore is 1,00,00,000 or ten million (written as 10,000,000 outside India). Large numbers are most commonly expressed with these two terms in Indian English. Following this logic, one crore is equal to 100 lakhs.

Don't let unit conversion scare you, though. A foolproof way to move from one measurement unit to another is to **multiply by one**. Well, not precisely by the number 1, but by a **fraction** with that value: 60 min/1 h, or 1 m/100 cm. If you consider only the numbers in these kinds of fractions, the result would be different than 1.

However, if you look at the measurement units, you can easily see that their value is effectively 1; 60 minutes is equal to 1 hour.

$$40\ \frac{\text{km}}{\text{h}} = 40\ \frac{\cancel{\text{km}}}{\cancel{\text{h}}} \times \frac{\cancel{\text{h}}}{60\text{min}} \times \frac{0.62\ \text{miles}}{\cancel{1\ \text{km}}} = 0.41\ \frac{\text{miles}}{\text{min}}$$

Choose the correct fractions with the unit you want to cancel on the "other side" of the fraction bar. If you have ever wondered what is the maximum speed of a wombat (when threatened) in miles per minute, the multiplication by unitary fraction serves you well.

Remember to choose consistent measurement units: You can't use fractions with, for example, length as the numerator and time as the denominator!

CALCULOTTER TIP

Crore to Lakh

Still confused? Here's a handy conversion tool for crores and lakhs.

Conversion Calculator

For the most commonly used units in one conversion calculator.

CHECKING YOUR CALCULATIONS

Mistakes happen everywhere, and even though it may sound weird, the history of science is full of them. To be honest, mistakes help us better understand what's right and are often more helpful than correct results (if we leave scientific misconduct alone).

Calculations are one of the most common sources of mistakes. Numbers are easy to get wrong, and it's not difficult to get a sign incorrect.

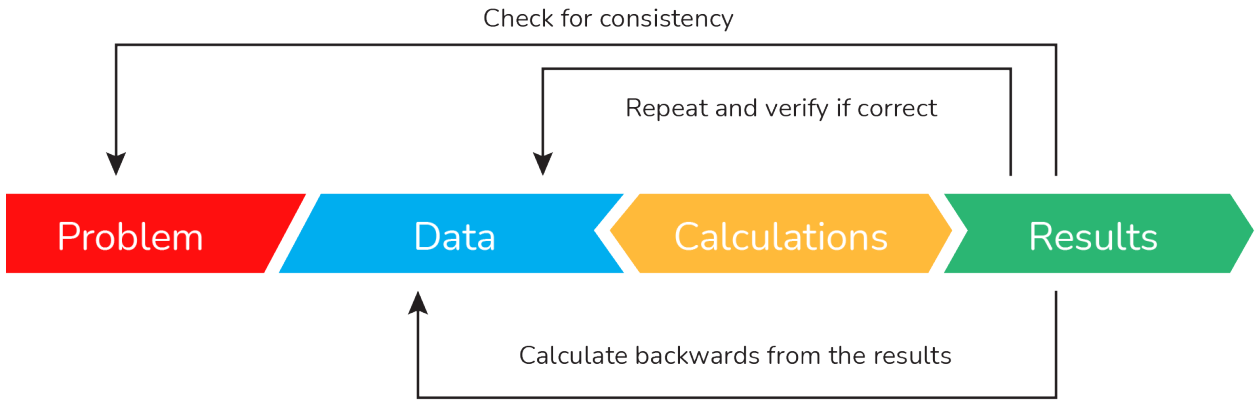
To **check your calculations**, proceed in **steps**. The **first step** is **always** to check your sources. Read that PDF again, ask again, or return to your notes. It only takes a minute but can save you more time in the long run!

VERIFYING SOURCES

Sources sometimes give estimates that are far from the actual distance. For example, one reporter recalled that during the retrieval operations after super typhoon Rai (Odette) in the Philippines, the police blotter incorrectly stated that a dead body was found 100 meters away from their household. When the reporter confirmed this, she found that the distance was only 10 meters away. The reporter was able to double-check the information and correct the error. According to her, such errors may be attributed to the traumatic situation they were dealing with at the time.

Once you've reached the end of the problem, move back to the beginning and check if the solution satisfies the original question. This tip is particularly true for **equations**.

You can also run **backward** through your calculations, if possible!



If you are dealing with many operations, try to repeat the calculations by **changing** some steps in the process. A bit of variation can help spot mistakes that otherwise would go unnoticed.

SHORTENING NUMBERS

A reporter has a hard time comparing figures or tables when the numbers are shortened with a general note of "in thousands" or "in hundreds," a common feature in tables showing key performance indicators and budgets.

Consistency is the key to an easy understanding of numbers and data.

It's totally fine to shorten numbers with a "textual" name: hundred, thousand, million. However, this increases the likelihood of a mistake.

Remember that even if expressed as words, those are still numbers! Never treat them as units and wrongfully—remove them from your calculations just to put them back at the end!

Remember to count your zeros

There are no rules to do so, but they mostly move in groups of three.

Perhaps the most common mistake when writing numbers is writing about especially big—or especially small—ones.

Journalists in a hurry can sometimes mistake billions for millions or vice versa. When referring to monetary amounts, these mistakes can have vast implications for the story's context. Place value mistakes can further be compounded when a reporter takes a wrong number to compute for a different value.

For instance, if a reporter is trying to compute 23% of 1.5 billion, he might make the mistake of dropping one or two zeroes. 1.5 billion or 1,500,000,000 has eight zeroes, and 23% of 1.5 billion is 345,000,000 or 345 million. If a zero is dropped, the resulting value will also be off.

CALCULOTTER TIP

Million-to-Billion | Billion-to-Trillion | Numbers-to-Words

Check out these useful tools to help you with larger numbers.

When dealing with a problem in physics (or biology, or any other "real world" science), pay attention to the **meaningfulness of your results**. The math may be correct, but it would make no sense to talk about a room's temperature and find a result of a thousand degrees. In that case, **the error lies in the problem setup**.

To check if a result is meaningful, you need a bit of intuition and common sense:

- Set a **lower bound**. If you are calculating the total oil production (barrels per day) in Saudi Arabia, you can expect the result to be higher than a few thousand.
- Set a **higher bound**. If you are calculating the speed of a car crash, you can expect the result to be lower than 500 km/h.
- Think about the physical quantity you are calculating. Can it assume negative values?

READ REPORTS THOROUGHLY

Reporters usually have to crunch a large set of data when writing audit reports. One common mistake is not taking the time to read through the entire section, which could lead to computation errors.

One reporter working on a story regarding the audit report on a branch of the judiciary was confused when the audit report cited that the agency, on average, only utilized about 6.75% or P42.264 million of its allocation to spend on Personnel Services (PS), Maintenance and Other Operating Expenses (MOOE) and Capital Outlay (CO)—technical terms that refer to salaries and day to day spendings of a government agency.

His confusion stemmed from the wording of the audit report, which said:

"Out of the authorized average annual budget of P1.380 billion allotted for Personnel Services (PS), Maintenance and Other Operating Expenses (MOOE), and Capital Outlay (CO) received for CYs 2019, 2020, and 2021, only an average of P42.264 million or 6.75 percent was utilized or spent annually by the agency."

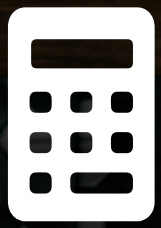
On first reading, the reporter assumed that the audit body was saying that 6.75% of P1.380 billion is P42.264 million. He inputted the numbers into a percentage calculator tool and was confused to find that 6.75% of 1.380 billion is 93.15 million. He either got his math wrong, or the audit body made a mistake.

Puzzled, he reached out to a fellow reporter who pointed out that he **missed the word "average" in the original audit report**—and failed to look at the tabulated data provided further down the page.

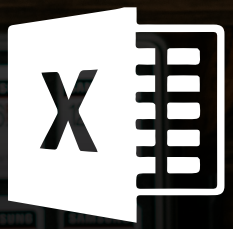
Upon re-reading, he sighed a huge sigh of relief that he didn't submit an erroneous story: It turns out that the agency in question received P4.14 billion in total budget over the course of three years, the average of which is P1.380 billion.

Furthermore, the reporter realized that the 6.75 percent figure was also an average: In 2019, the agency only utilized 6.34% of its budget, while in 2020 and 2021, it spent 6.32% and 7.58%, respectively.

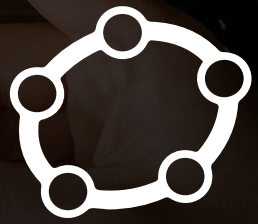
TOOLS TO HELP YOU



Your **handheld calculator**.



Microsoft Excel (or any spreadsheet). If you know how to use them, they can boost your calculations—in particular, if you are handling a lot of data. If you don't know how to use them, learn!



Download **GeoGebra**, a useful and versatile tool that includes many functionalities, from plotter to spreadsheet.

Last but not least, the best way to check your calculations is to **repeat them**. It may be slightly time-consuming, but it can save you from embarrassing errors.

At any step, don't be scared of using **trustworthy tools**, from your desk calculator to online tools.

Paper and pen are the most basic tools you can use to calculate and check your calculations. However, doing so can get tiresome. You can get help from many sources, such as the tools mentioned above.

At Omni Calculator, we think that it's good enough to understand what you are doing, but when it comes to hard numbers, you can leave the calculations to computers: They are better than us at that! But remember: if you input bad data, you get bad answers. Using a calculator is not a magic way to get the math right. **You have to understand it first**.

03
STRENGTHENING YOUR STORY

VISUALIZING YOUR DATA

No one wants to squint through spreadsheets or crawl through vast blocks of text, but creating visualizations from raw data is a daunting task. We've compiled a few tools below from a variety of categories.

TOOL	PROS	CONS	BEST FOR	PRICE
Datawrapper	Offers a wide selection of visuals (such as graphs, maps, and tables) can be interactive on digital media.	Requires an internet connection to work it.	Smaller projects (both in scale, timeline, and team size).	**Basic Plan** Free **Paid Plan** $599 per month
Flourish	Team-based features allow for easy collaboration on larger projects.	Free plan includes no teamwork features. Requires the internet.	Larger projects (wider scope, bigger team, and over a longer time).	**Basic Plan** Free **Paid Plan** $999/month for 10 users
Microsoft Excel	Well-known, powerful and customizable spreadsheet editor.	Visuals are solid but not as visually appealing as other solutions.	Working in low-connectivity areas.	**Personal Plan** $69.99 per year
Google Sheets	Entirely free, accessible, and easy to share and collaborate with others.	Requires an internet connection and lacks some features that Excel has.	Highly real-time collaborative projects.	Free

Using programming to visualize data

If you have the technical inclination and the time to learn, you can visualize your data for free with the help of programming languages.

PROGRAMMING LANGUAGES

Python
A general-purpose language. Offers the *Matplotlib* and *Seaborn* toolkits.

R
A language designed for statistical analysis. Has built-in plotting capabilities.

Plotly
or other free plotting frameworks integrate well with *Python*, *R*, and other languages.

PROS	CONS	BEST FOR	PRICE
Powerful in the hands of a skilled user. Offers high degree of customizability in graph creation.	Requires technical know-how to use well.	Projects with a strong scientific orientation.	Free

How to visualize data effectively

Data visualizations are easy to make nowadays, but with this ease of access comes a lower barrier of entry and lower-quality visualizations. What's more, visualization can be a powerful tool for those trying to be dishonest—and a reader unfamiliar with good data visualization principles might be tricked by the implicitly perceived trustworthiness of a graph. It is these principles that we explain in this section.

Bar charts are fine for plotting a categorical (qualitative) variable against a numerical (quantitative) variable, e.g., plotting genders' average IQs, car models' CO2 emissions, and the number of votes each political party got in an election.

Pie charts are great when a small number of categorical variables are compared against a numeric variable representing a share in something. Any more than three categorical variables, and you're better off using a bar chart. Pie charts are good for data such as the yes/no/maybe votes in a survey, but not so good for comparing the GDPs of all 44 European countries.

Scatter plots are useful when there are individual data points with two or more variables attached, such as a sample of a hundred people's heights and weights or a sample of countries' GDPs and Human Development Index (HDI) scores.

Line charts are best used to represent the change in a variable over time, such as a country's pollution and population levels.

Knowing **what type of chart to use** is half the battle.

Visualizations should be clean and communicate as much information as possible with as few visual elements as possible. Less is more: Favor monotone colors, don't use unnecessary special effects (such as 3D in a bar chart), and use easy-to-recognize shapes (e.g., circles, triangles, and squares in a scatter plot).

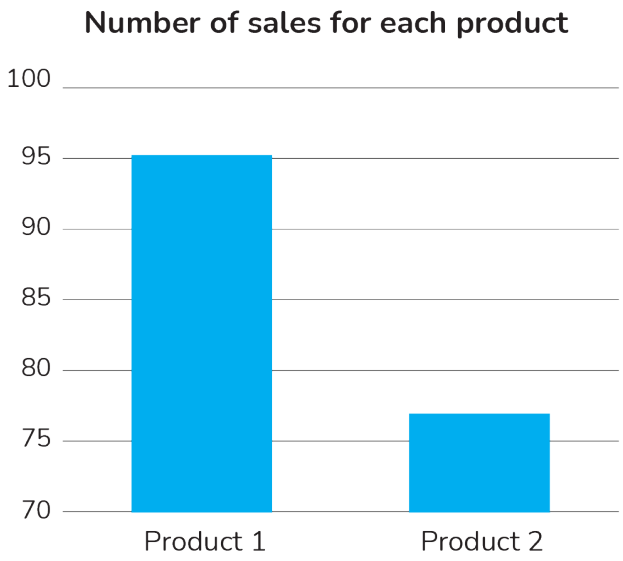
Tell a story.

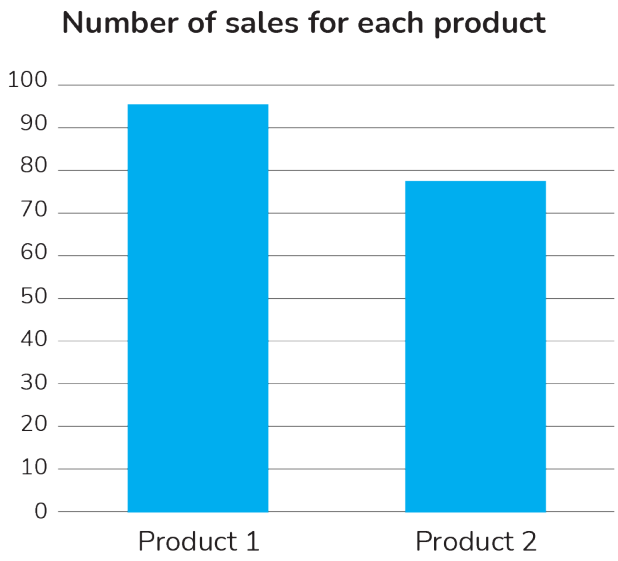
The point of a visualization is not simply to report data visually but to **tell a story around that data**. There is a point you're trying to make, and that point should inform what visual elements you include. If your aim is to emphasize a recent surge in crime, then you might include a horizontal line indicating the normal average crime rate. Look at your visual and ask yourself if the average reader (who might not even have read the full story accompanying it) would immediately understand the point you're trying to get across.

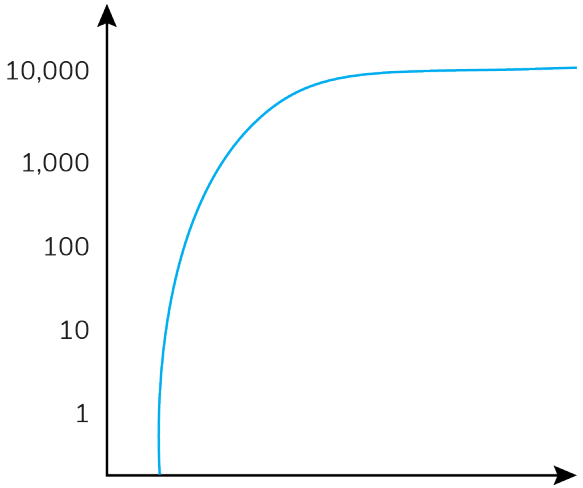
RELATABLE VISUAL EXAMPLES

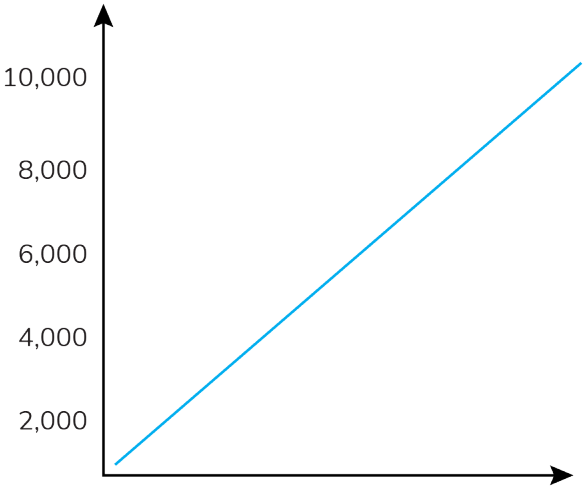
Visualizing local reclamation stories is often tricky because the lack of data and its slow onset impacts aren't as emotional as other environmental and social issues. So when figures are available, the challenge is to make sense of and find baselines for comparison given the large numbers and gaps in a dataset.

Accurately converting these figures into relatable visual examples (e.g., 174 hectares is equivalent to 4000 basketball courts) for your audience to better understand the facts is another important challenge so they'd be aware of how these complex data affect them in the long run. It's truly a back-and-forth exercise on further humanizing what may be solely seen as just numbers.









The y-axis should start at 0. When making a chart that relies on a sense of vertical scale (such as in a bar chart), the graph's y-axis should start at 0 to give the reader that perspective. If not done this way, the smaller bars in the chart would appear smaller in comparison, giving a false impression of the reality that the graph presents. You can break this rule if doing so doesn't affect the data or avoids large swaths of empty space (such as what would happen in a scatter plot).

Use intuitive axis scales. If you represent the same data on two scales (one linear and one logarithmic), the graph will look completely different.

The logarithmic scale has its place in scientific media, but everyday media should use linear scales on their axes as that's what most people are familiar with.

FACT-CHECKING AND ITS IMPORTANCE

JOURNALISM IS AND SHOULD BE ALL ABOUT TELLING THE TRUTH.

But sometimes, mistakes happen—our sources sometimes make a wrong claim, or even journalists do when writing a story.

Social media can be a huge trap, too. Not everything going viral is correct, yet people keep sharing photos and videos across news feeds and chat groups. Quote cards attributed to a particular official get twisted out of context or are purely made up.

Here's where the practice of fact-checking comes in handy: It's **a chance to set the record straight**.

Vera Files, an independent news organization and Facebook's third-party fact-checker in the Philippines, says fact-checking is a way to respond to "false, misleading, or incorrect statements or claims" made by public officials and other prominent figures, whether it was intentional or not.

USE YOUR SPIDEY SENSE

During the 2022 presidential campaign in the Philippines, the camp of one national candidate claimed they drew out 500,000 supporters across a 12-kilometer strip of road in Las Piñas City. This figure was supposedly based on police estimates.

Here's where your "Spidey sense" would come in handy: A crowd of half a million is technically doable (against a national population of 110 million), but not when you know that Las Piñas, located in the southern part of Metro Manila, is a mid-sized city relative to the region with 606,293 residents.

FACT-CHECK THE REPORT

1. Go back to the source material

Retrieve the original and complete video clip, audio file, image, or written statement containing the questionable claim. Save a copy and check if it was altered or stitched together from multiple clips. The latter is a red flag in itself.

2. Check the date and time when the claim was made

It could have been factual at the time but may have been overtaken by succeeding events. After all, context is king. Sometimes, the fact-checking process may already end here. For example, the claim ceases to be true because of a policy change.

3. Compare the claim to facts

Online research is the easiest way to go. Just make sure you are retrieving the information from reputable sources such as existing laws, court rulings, official documents, or publications in academic journals. Remember to retrieve these from official websites, and be sure to mention these data sources in your text. For example the top-level domain name for government pages is ".gov" and ".edu" for academic institutions.

4. Tap an expert

Sometimes, it helps to bring in a subject matter expert to explain why the statement you are fact-checking is wrong or does not make sense—their authority lends more weight to the whole ordeal. A "talking head" also helps break down the issue and make it more relatable to the layperson.

5. Use online tools to verify

Thanks to technology, there are now multiple ways to “reverse search”—that is, to see whether the photo, article, or quote you are fact-checking has appeared online before. This is extremely useful to guard against misrepresented or altered photos and statements supposedly issued by a personality.

Google’s image search allows you to upload a photo, and the search engine will check if the same picture has been uploaded elsewhere. The Reuters Fact Check team debunked this circulating photo on Twitter which allegedly depicts a child crying in the middle of a battlefield while sitting beside her mom’s corpse. The original post claimed it was a scene out of Kyiv in the middle of the Russia-Ukraine conflict.

A reverse image search revealed it was instead a staged scene for a 2010 film called “The Brest Fortress” that portrayed the 1941 Nazi invasion of the Soviet Union instead.

6. Give a rating

This would be the gist of it all: **Is the claim true or false?** Often, it is written in big, bold letters on top of the fact-check piece. Some journalists would also rate claims as “needs context,” “partly true/false,” or “altered.” The latter applies to manipulated photos and videos. However, not all fact-checking organizations assign ratings to their findings.

Circling back to the Las Piñas City example, journalists first retrieved photos of the supposed campaign gathering for a quick eye test. They found that the crowd looks far from 500,000 heads for the entire motorcade or political rally.

An interview with local authorities likewise confirmed it was false. Reporters went back to the Las Piñas City police chief, who said their official crowd estimate was 18,000! A far cry from half a million supporters.

> **IT'S HARD TO MAKE SOUND DECISIONS WHEN PEOPLE DON'T HAVE ENOUGH INFORMATION. IT'S EVEN HARDER WHEN WHAT YOU KNOW TURNS OUT TO BE WRONG.**

Presenting numbers in the proper context—meaning the figures went through the correct calculation and compared to the appropriate reference number—makes your entire report more solid and believable.

A proper and fact-checked piece also builds your credibility as a journalist and fortifies trust in your news organization or platform.

FACT-CHECKING IN THE NEWSROOM

An American senator questions the safety of COVID-19 vaccines and warns it might be causing more deaths, citing unverified information from the US government website Vaccine Adverse Event Reporting System (VAERS).

Here's how CNN fact-checked it.

"WE'RE OVER 3,000 DEATHS AFTER WITHIN 30 DAYS OF TAKING THE VACCINE,"

— Republican Senator Ron Johnson of Wisconsin in a May 2021 radio interview

CNN reaches out to Johnson's senior communications adviser, who says **the senator is not suggesting direct causation** between vaccination and deaths but wants "research" on the data.

US Centers for Disease Control and Prevention: VAERS received 4,178 reports of death (0.0017%) among people who received a COVID-19 vaccine from December 14, 2020, to May 3, 2021.

"A REVIEW OF AVAILABLE CLINICAL INFORMATION, INCLUDING DEATH CERTIFICATES, AUTOPSY, AND MEDICAL RECORDS HAS NOT ESTABLISHED A CAUSAL LINK TO COVID-19 VACCINES."

— US Centers for Disease Control and Prevention

THE REAL NUMBER

CDC says it was "plausible" that the Johnson & Johnson vaccine may have caused dangerous blood clotting that killed **3* out of over 8 million vaccinated Americans.**

**vs. senator's claim of over 3,000.*

RATING: ENTIRELY FALSE!

ALWAYS QUOTE YOUR SOURCES

SOURCES, SOURCES, SOURCES.

In a connected world where everyone can publish everything on a wide array of media and websites, finding reliable sources is harder than ever. Humanity is new to this: In the past, books and newspapers were the major sources of knowledge; the effort behind creating such materials largely left out much of the untrustworthy information for centuries.

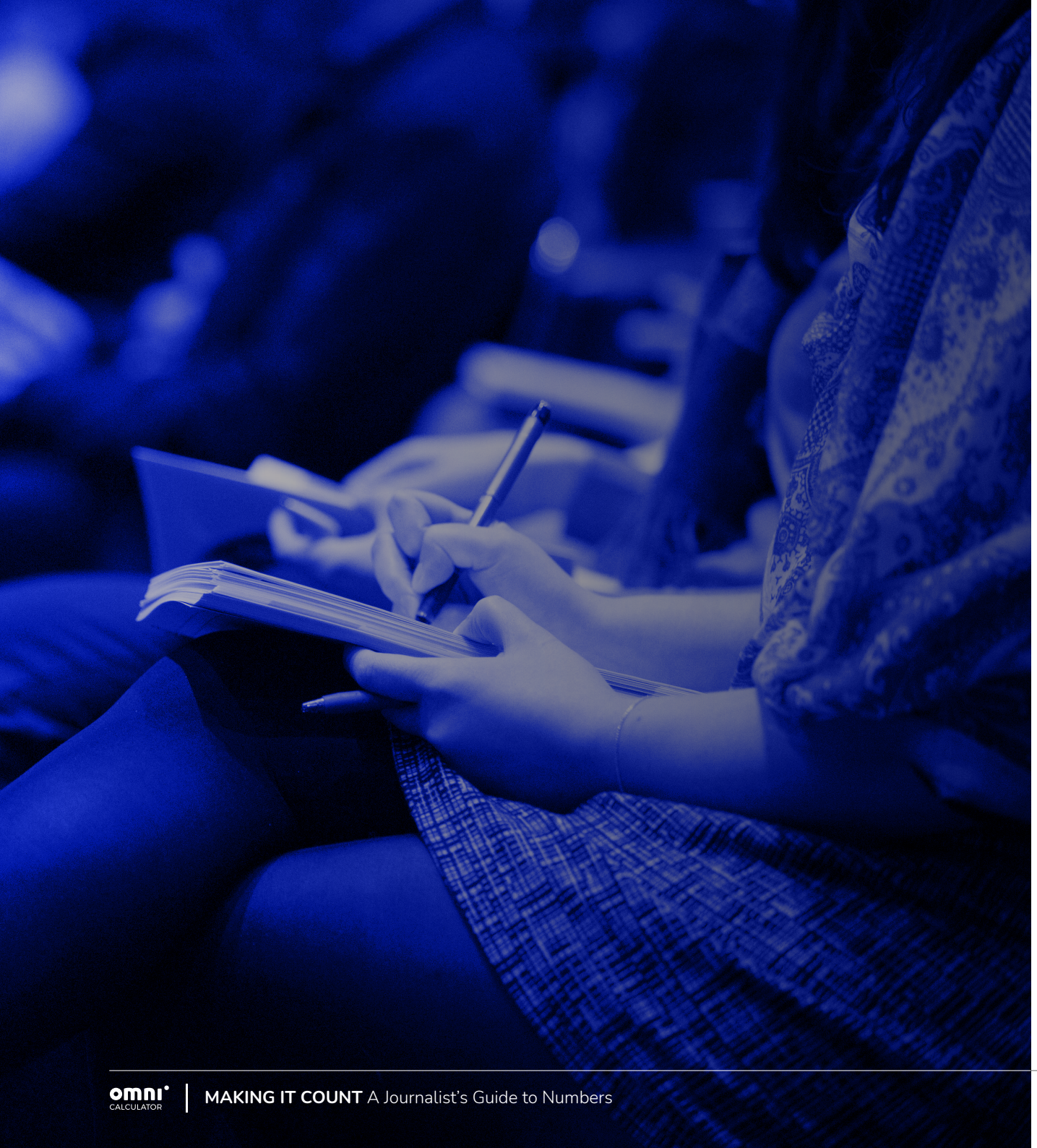
In the 21st century however, we saw the rise of the Internet as a boundless repository of human knowledge, finally free from the limitations of books and libraries, and where anyone can publish anything.

Which leaves us with the question: *How do we find reliable sources in this vast ocean filled with wisdom, or lack thereof?* The first and foremost condition is that your sources are backed up by either other reliable sources (which gives them a hint of reliability thanks to "transitivity"), have gone through a system of revision by a trustworthy group of individuals, or are the direct product of research from trusted and official institutions. For instance, if you're looking for data about climate change, scourging the reports of the Intergovernmental Panel on Climate Change (IPCC), authored by some of the most trusted scientists in the field, is a safe bet.

So, what and what not to trust?

GOOD	**Primary or secondary sources**	Original research or works based on it, if reputable, has a green light. As a rule of thumb, scientific journals are trustworthy (and thankfully so), and other really sectorial publications can also be trusted (possibly if they are widely known).
	Online collections of tools and research	Omni Calculator is here along with other websites (Scholarpedia, a peer-reviewed online encyclopedia, for example, or this statistics handbook). If they are clear on their purpose, you can use them to help your work. You won't find data here: These tools save you time when you need help with math!
	Data repositories	Repositories that report sources (and the sources are not friends or surveys on Twitter) can be used for your pieces (ourworldindata.org and statista.com are particularly good). The original sources are even better, though a bit harder to access and understand. However, if you have time on your hands, a visit to data.un.org is probably worth the effort.
CAUTION	**Encyclopedias**	(Wikipedia included) should be used only for rather generic queries: They are good at answering questions that don't require a strong backup. For example, you can look for the first six digits of pi on Wikipedia; however, if you are looking for the latest record in computing the constant, you should refer to specialized publications. *There's no warranty that Wikipedia is up to date.*
	Other news services	While some can be almost always trusted, others may be downright malicious. Use your judgment, and always assess if there is a risk of polarization or bias.
	Not yet (or not) peer-reviewed scientific works	Preprints (papers waiting to be reviewed) may contain mistakes or false claims. It's not good practice to use them as a source, even in the academic field.
BAD	**Self-published content**	Both online and offline. A blog post is not a source, even if it comes from an A-class scientist. Take them as opinions and comments, but not sources! The lack of review and control of the content allows the publication of unverified information, personal hypothesis, and—sadly—purposefully or involuntarily misinformation.
	Anything coming from social media	Of course! Social media networks are resonating chambers for every kind of misinformation. Never quote a Facebook post or a Twitter thread: Dig a bit deeper. Check for the original source, the press release, or the research underlying the post. If this is not satisfying, here is the New York Times, a reliable source according to Wikipedia, but rather funnily not employing a copy editor also for their social media: nothing stops them from misreporting the numbers!

04
WHO BUILT THE GUIDE



THE JOURNALISTS

To ensure that this guide has everything that a reporter needs, Omni Calculator collaborated with several journalists from different fields.

These are all people dedicated to delivering the truth to their readers and who understand the power that numbers can add to a story.

YVONNE T. CHUA

Editor / Journalism Educator

Yvonne is a veteran journalist and an associate professor of journalism at the University of the Philippines, where she teaches journalism ethics, investigative journalism, data journalism, and fact-checking. She believes that numbers matter—and shouldn't be lost in bad storytelling.

PATRICIA DENISE CHIU

Journalist

Patricia is a Manila-based reporter who has covered political and business news for publications such as GMA News Online, the Financial Times, and the Philippine Daily Inquirer. She currently covers Southeast Asia for The Asset. Like most journalists, she was previously wary of math and numbers but has learned to embrace them to tell holistic and balanced stories.

ROBBIN DAGLE

Researcher/Journalist

Robbin is a Lecturer at the Department of Communication of the Ateneo de Manila University. Trained as a campus journalist in college, Robbin still works as a freelance journalist, writing local government stories on COVID-19 figures and public works—all of which require math and statistical knowledge.

MELISSA LOPEZ

Journalist

Melissa is a business reporter based in Manila who has written for print, online, and TV. She earned her Journalism degree, magna cum laude, from the University of the Philippines Diliman. Math and numbers are part of day-to-day life, and she believes it is a journalist's duty to make sense of them.

JULIANNE SUAZO

Journalist

Julianne is a lifestyle journalist based in Manila and London whose bylines have appeared on CNN Life, Philippine Star Supreme, MEGA Magazine, Eater, Resy, Service95, and more. Through numerical facts and figures, Julianne is able to draw out clarity from stories.

We'd like to extend our gratitude and thanks to the following people who helped make this guide possible:
Avigail Olarte *(former CNN the Row editor)*, Regine Cabato *(Washington Post reporter)*, and Paolo Vergara *(freelance journalist)*.

OMNI CALCULATOR

Omni Calculator is a website dedicated to helping people make more informed decisions about the world around them by creating a kaleidoscope of **convenient calculators accessible to everyone**.

This kind of work understandably attracts people who love numbers and rationalizing the world around them. However, a company cannot be run exclusively by people whose idea of a good time is staring at a spreadsheet.

That's why Omni Calculator is also full of people passionate about getting the word out to the world and displaying data so everyone can make sense of it.

REINA SAGNIP
Project Manager

Reina graduated cum laude with a BA in Psychology from De La Salle University. Fueled by her love for organization and leadership, as well as her disdain for misinformation, she co-led this initiative to ensure that everything ran smoothly.

SAM BALBOA
Project Manager

Sam holds a BFA in Information Design and an MSc in Innovation Management. She initially developed the idea for this project—a step in line with Omni Calculator's initiative to help change how the public perceive numbers.

MARJORIE CHAN
Graphic Designer

Marjorie is a seasoned graphic designer with experience in illustration, branding, and motion graphics, having worked for GCash and the Australian real estate industry. While art and numbers may seem at odds, she thrives at attempting to bridge the gap between aesthetics and precision.

DAVIDE BORCHIA
Researcher

Davide holds an MSc cum laude in Theoretical Physics at the University of Turin. Since his student years, he developed an interest in communicating science the right way. He can explain to you what a derivative is on a napkin. His mission is to help physics and mathematics lose their bad reputation.

RIJK DE WET

Researcher

Rijk is a South African data scientist. His industrial engineering Master's dissertation at Stellenbosch University specializes in developing swarm intelligence algorithms. He believes that every problem can be solved with a handful of equations and a few lines of code.

JACK BOWATER

Researcher

Jack possesses both an MSc in Pharmaceutical Sciences and a BSc in Chemistry. He is committed to pursuing truth and beauty in whatever forms they are found and in whatever unlikely places. He also enjoys programming on the side.

STEVEN WOODING

Researcher

Steven holds a 1st class degree in Physics from the University of Surrey and is a member of the Institute of Physics. In his role at Omni Calculator, he ensures numbers are communicated correctly and clearly on the website by reviewing and proofreading content. He is always curious about where a number comes from and its validity.

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