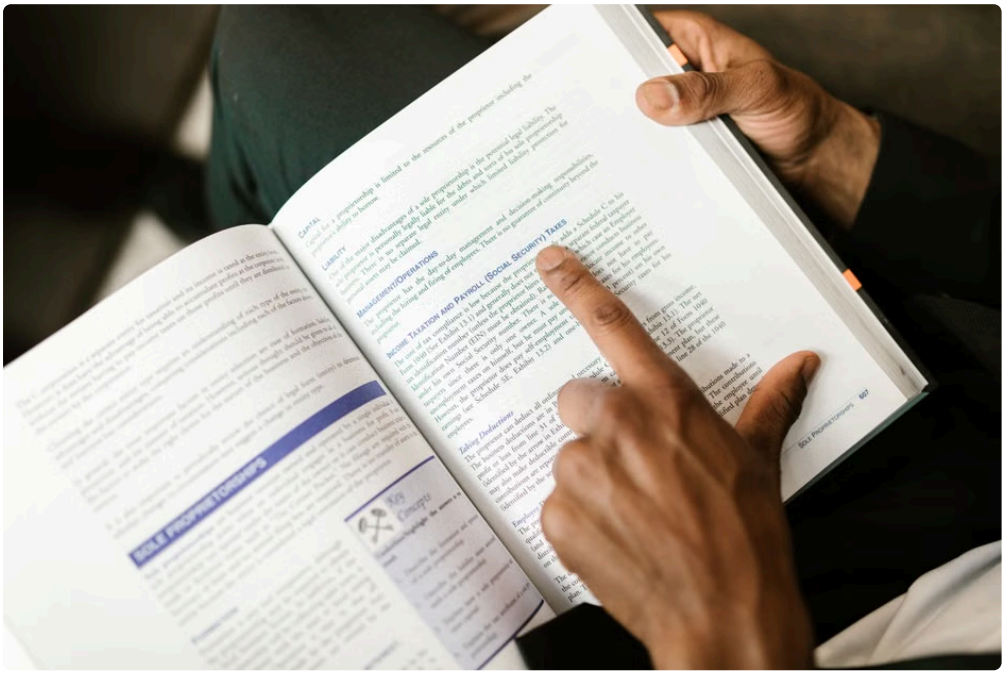
A chart can show how much has accumulated, how quickly something is changing, or both. Those are different questions. Confusing them can lead to mistakes in a shipping report, an inventory dashboard, or a finance summary—for example, calling "240 packages" a rate when the chart actually shows a total.

Here is a simple rule to keep in mind: **a total tells you how much; a rate tells you how much per unit of time.** Before doing any math, ask: **What are the units?** Then check the axis labels, identify what accumulated, and look for "per time." The checklist below helps you make that distinction, interpret changes, and avoid reading more into a chart than it shows.

The simplest checklist

1. **Check the axis labels.** What does each axis measure? Does the vertical axis show a quantity, such as packages, dollars, or liters, or a quantity per time, such as packages per hour?
2. **Ask what accumulated.** Is the plotted value a running total from a starting point, or a separate amount for each interval?
3. **Look for "per time."** Units such as dollars per month, orders per day, or miles per hour indicate a rate.
4. **Find the start time.** If the chart shows a cumulative total, what time does the accumulation begin? A total without a clear starting point can be hard to interpret.
5. **Check the interval.** To calculate an average rate of change, identify both endpoints and the elapsed time between them.
6. **Notice whether events happen in jumps.** If the data records deliveries, payments, or inventory updates at particular times, don't draw a sloping line that suggests changes happened continuously between those times.

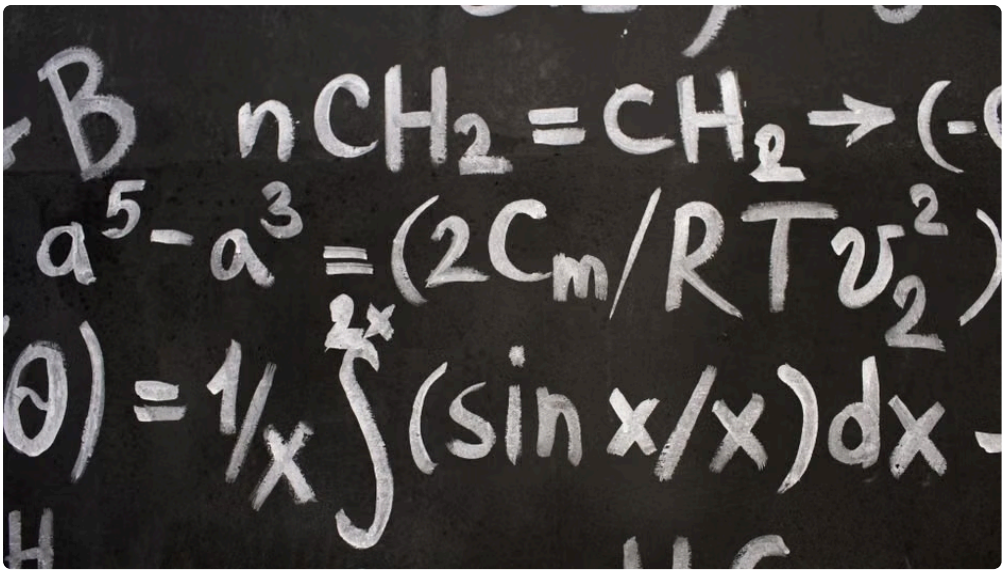
These steps are useful whether you are reading a chart someone else made or creating one yourself. They also work as a quick quality check: if you can't tell what a value measures, what its units are, or when accumulation starts, the chart needs clearer labels.



Totals and rates answer different questions

A total answers “How much altogether?”

A total is an amount measured over a stated period or accumulated from a stated starting point. Examples include:



- 480 packages shipped since 8:00 a.m.
- $2,400 in sales during the month
- 150 liters in a storage tank at noon

These values have units of packages, dollars, and liters. They do not, by themselves, say how quickly the amount changed. “480 packages” is a total, not a rate.

A rate answers “How much per unit of time?”

A rate compares an amount with a time interval. Examples include:

- 60 packages per hour
- $800 per week
- 12 liters per minute

The units contain “per,” or are written with a slash: packages/hour, dollars/week, or liters/minute. That is the clue that a rate is involved. A rate describes pace. A total describes amount. One may help you calculate the other, but they are not interchangeable.

For example, a shipping dashboard might report that the warehouse shipped 240 packages between 9:00 and 12:00. That is a total for the interval. The average shipping rate over the interval is 240 packages divided by 3 hours, or 80 packages per hour. The answer changes because the question changed.

Read the axes before interpreting the graph

Start by reading both axis labels, including their units. A chart with time on the horizontal axis could show many different things on the vertical axis: a running total, a rate, a temperature, an inventory level, or a per-period count. Time on the horizontal axis does not automatically make the other axis a rate.

Vertical-axis label Likely quantity Question it can answer Packages shipped Total or count How many packages? Packages shipped per hour Rate How quickly are packages being shipped? Inventory on hand (items) Amount at a point in time How many items are currently in stock? Revenue ($) Amount or total, depending on the chart’s definition How much revenue is shown? Revenue per day ($/day) Rate How quickly is revenue being earned?

Some labels still need more detail. “Packages shipped” could mean the count during each hour or the cumulative number shipped since the shift began. Those are different recorded quantities, even though both use packages as their units. Look for words such as *per hour*, *this hour*, *cumulative*, or *since opening*. If they are missing, check the chart notes or ask the person who created it.

Ask what accumulated—and when the count began

A cumulative chart adds new amounts to previous amounts. A warehouse might record packages shipped at the end of each hour and add each hour’s count to the running total. If the hourly counts are 40, 55, and 65, the cumulative values are 40, 95, and 160. The hourly counts answer “How many this hour?” The cumulative values answer “How many so far?”

To interpret a cumulative total, define the recorded quantity in one clean sentence. For example:

“This chart shows the cumulative number of packages shipped, starting at 8:00 a.m.”

That sentence names what is recorded, says that it accumulates, and provides a start time. Without the start time, “160 packages” could mean 160 since the shift began, since midnight, or since a reporting system was reset. In finance, the same issue comes up with sales totals, balances, and year-to-date figures.

Also distinguish a cumulative total from a balance or level. The number of items in inventory is usually a current amount, not the total number of items ever received. Inventory can rise when deliveries arrive and fall when orders go out. Its value at noon describes the level at that time; it does not tell you the total throughput for the day.

Intervals matter for average rate of change

To find an average rate of change, you need a change in quantity and the elapsed time over which it occurred. In plain language:

Average rate of change = change in quantity ÷ change in time.

If a cumulative shipping total rises from 120 packages at 10:00 a.m. to 300 packages at 1:00 p.m., then the increase is 180 packages over 3 hours. The average rate is:

\[\frac300-120\text packages1\text p.m.-10\text a.m. = \frac180\text packages3\text hours = 60\text packages per hour. \]

The units show why this is a rate: packages divided by hours gives packages per hour. MathJax can render this notation in a web page, but the reasoning does not depend on special software. The essential step is to name the two endpoints and the time interval between them.

That value is an *average* rate for the whole interval. It does not prove that exactly 60 packages were shipped in every hour. Perhaps the team shipped 90 in the first hour, 30 in the second, and 60 in the third. An average smooths over those differences.

Be specific about the interval, especially when chart readings are taken at uneven times. Comparing a change over 15 minutes with a change over 4 hours without adjusting for elapsed time can make the faster period look slower—or the slower period look faster. If the time axis uses clock times, convert the interval to consistent units before dividing. For instance, 90 minutes is 1.5 hours, not 90 hours.

Use a step graph when the data changes in jumps

Some quantities change continuously; others are recorded as separate events. A truck may deliver 50 items at 9:00, and the inventory count may jump at that moment. If the chart draws a diagonal line from the earlier value to the later one, it suggests that the items arrived gradually between those timestamps. That visual story may be false.

When changes happen at recorded moments, use a step graph or clearly marked points. A step graph holds the recorded value steady between events and then shows a jump when the event occurs. It is often a better fit for inventory counts, completed shipments, and payments posted at specific times.

For a rate chart, a line connecting measurements can be appropriate when the underlying rate is understood to vary between observations. But a line is not proof that the data was measured continuously. Check what the chart represents before reading the space between points as observed data.

A practical dashboard example

Imagine a chart labeled “Orders” with time along the bottom and values 20, 35, 50, and 70 on the vertical axis, recorded at the end of each hour. The title and axis label alone do not tell you whether those are orders completed during each hour or a running total. Ask:

- Does each value mean “orders this hour” or “orders so far”?
- Are the values counts of orders, or orders per hour?
- What time did recording begin?
- Are the timestamps one hour apart?

If the values are hourly counts, then 70 orders at 1:00 means 70 during that hour. If they are cumulative counts, then 70 at 1:00 means 70 since the stated start time. If the chart explicitly says “orders per hour,” the values represent rates. A few words in the label can change the correct interpretation entirely.

A reusable chart-reading checklist

When you encounter a chart at work, write down or say the following before calculating:

1. **Quantity:** What is being recorded?
2. **Units:** What are the units? Do they include “per” time?
3. **Meaning:** Is the value an amount at a time, an amount during an interval, or a cumulative total?
4. **Starting point:** If it accumulates, when does the accumulation begin?
5. **Interval:** If I’m comparing values, how much time has elapsed?
6. **Display:** Do the marks or connecting lines match how the events actually happen?

Then rewrite the chart’s meaning as one clean sentence. For example: “The vertical axis shows the cumulative number of packages shipped since 8:00 a.m.” Or: “The vertical axis shows the number of orders completed per hour.” If you can’t write that sentence confidently, don’t calculate yet. The chart needs clarification.

Using MathJax and Runestone for learning

MathJax is a tool for displaying mathematical notation on web pages, such as an average-rate formula. It can make expressions easier to read, but it cannot fix https://activecalculus.org/author/Running-Totals-Rates-of-Change unclear chart labels or decide whether a value is a total or a rate. The interpretation still comes first.

Runestone is an interactive publishing platform that educators can use to present lessons and activities. A chart-reading exercise in Runestone could ask learners to identify units, distinguish cumulative totals from per-interval counts, and calculate an average rate over a selected interval. Interactive questions are especially helpful when learners can explain why a label such as “packages per hour” means something different from “packages.”

The takeaway

Use the checklist in this order: **check axis labels, ask what accumulated, look for per time, identify the start time, and define the interval.** A total answers “How much?” A rate answers “How much per unit of time?” Units make the difference visible, and a clear time interval makes an average rate meaningful. Once those details are settled, the math is usually the easy part.