Key focus

This objective introduces the TSN framework for reading a time series graph (a line graph plotted against time): the long-term *Trend*, *Seasonality*, and *Noise*. Trend is the overall direction of the data over the long run and must be described as *increasing* or *decreasing* – never as "positive" or "negative," which describe number signs, not direction. Seasonality is a regular, repeating pattern tied to a fixed period (daily, weekly, quarterly, yearly). Noise is an unusual or unexpected point that doesn't fit the trend or the seasonal pattern – a one-off event, not a repeating one. Students learn to identify each component individually, then together in realistic multi-component datasets, and to justify their classifications with reasoning.

Suggested teaching sequence

1. Introduce the acronym TSN and define each letter before showing any graphs: Trend (long-term direction), Seasonality (regular repeating pattern), Noise (unusual one-off point).
2. Show a simple increasing time series (e.g. yearly profit) with no seasonality or noise. Ask students to describe the trend – correct any use of "positive"/"negative" immediately, replacing with "increasing"/"decreasing."
3. Show a time series with clear seasonality only (e.g. ice cream sales by month, repeating every year). Ask what makes this different from a trend: it repeats at a fixed interval, rather than moving steadily in one direction.
4. Show a time series with an obvious noise point (e.g. a graph with one unexplained spike or dip). Discuss what real-world events could explain it, and how noise differs from the start of a new trend (noise doesn't persist; a new trend does).
5. Combine all three components in one graph (e.g. increasing sales, with a Q4 seasonal spike each year, and one unusual dip from a store closure). Have students identify and justify all three.
6. Discuss how components can mask each other: strong seasonality can make an underlying trend hard to see at a glance, and noise can be mistaken for the start of a new trend if only recent data is examined.
7. Practise applying TSN reasoning to unfamiliar contexts beyond sales data: temperature records, website traffic, farming, tourism.
8. Discuss why TSN analysis is useful: separating trend from seasonality supports forecasting, while identifying noise helps distinguish genuine problems from normal variation.

Core examples to model

- Trend only: yearly company profit rising steadily from 2015 to 2020 – describe as "an increasing long-term trend," not "a positive trend."
- Seasonality only: ice cream sales higher every summer, year after year – a regular pattern tied to the calendar, not a one-off change.
- Noise only: a shop's sales drop for one week because of a burst pipe – an unusual, non-

repeating event that doesn't affect the overall pattern once it passes.

- All three together: a café's daily sales show overall growth (trend), are busier on weekends (seasonality), and spike once when a celebrity visited (noise) – each component is identified separately and justified with its own reasoning.

Watch for

- Describing trend as "positive" or "negative": these are number-sign words, not direction words. Always require "increasing" or "decreasing."
- Confusing seasonality with trend: seasonality repeats at a fixed interval and returns to a similar level each cycle; trend is the steady underlying direction once the seasonal ups and downs are looked past.
- Confusing noise with the start of a new trend: a single unusual point is noise; a new sustained direction over several time periods is a change in trend. Distinguishing the two often requires more data, not a snap judgement from one point.
- Assuming every time series has all three components: some datasets have trend only, seasonality only, or no clear pattern at all – students should not force-fit components that aren't present.
- Missing that seasonality can mask a trend: a strongly seasonal graph can look flat or erratic at first glance even when an underlying trend exists; students should look at same-period comparisons (e.g. this July vs. last July) to reveal it.

Checks for understanding

- Can students state what T, S, and N each stand for without prompting?
- Do they consistently describe trend as increasing/decreasing rather than positive/negative?
- Can they identify seasonality from a description or graph, and explain why it counts as seasonality (fixed repeating interval)?
- Can they identify noise and distinguish it from both trend and seasonality?
- Can they identify all three components together in one multi-component dataset and justify each choice?
- Can they explain how one component can mask another (e.g. seasonality masking trend)?
- Can they apply TSN reasoning to an unfamiliar context they haven't seen modelled?