

## 1. Residual Analysis as Anomaly Detection

**Residual Analysis:** Residual analysis is commonly applied in time series to detect anomalies. Residuals represent the difference between observed sales values and those predicted by the model (in this context, the seasonal decomposition model). By examining residuals, we can identify deviations from expected trends.

**Anomalies:** Large residuals (either positive or negative) often indicate anomalies. For example, if the seasonal model predicts higher sales in a particular month, yet actual sales fall short (resulting in a significant negative residual), this suggests an unexpected decline that may require further investigation.

## 2. Seasonal Component as a Benchmarking Tool

**Benchmarking Sales:** The seasonal component can indeed be used to benchmark sales performance. By analyzing historical data, businesses gain insights into predictable periods of high or low sales, typically aligned with seasonal patterns.

**Evaluating Performance:** When a company recognizes that certain months (e.g., September) historically bring higher sales, it can set expectations accordingly. If residual analysis then shows a noticeable drop in actual sales during such a high-sales month, this might indicate an anomaly requiring further analysis.

**Informed Decision-Making:** This combination of analyses assists businesses in evaluating performance relative to historical data and enables more strategic planning. Identifying peaks and troughs in sales allows companies to adapt marketing or inventory strategies to align with anticipated seasonal trends.

### Example Scenario

- **High-Sales Month Benchmark:** If the seasonal component indicates that September typically sees high sales, this establishes an expected benchmark for that month.
- **Residual Analysis:** If residual analysis reveals a decline in actual sales during September, contrary to the expected trend, it may signal an issue. This can lead the business to explore potential causes, such as shifts in consumer demand, competitor activity, or missed promotional opportunities.

### Summary

In summary, using both seasonal and residual analysis provides a dual approach to monitoring sales performance. The seasonal component offers a benchmark based on

historical patterns, while residual analysis highlights deviations, enabling businesses to respond proactively to anomalies and better align with performance expectations.