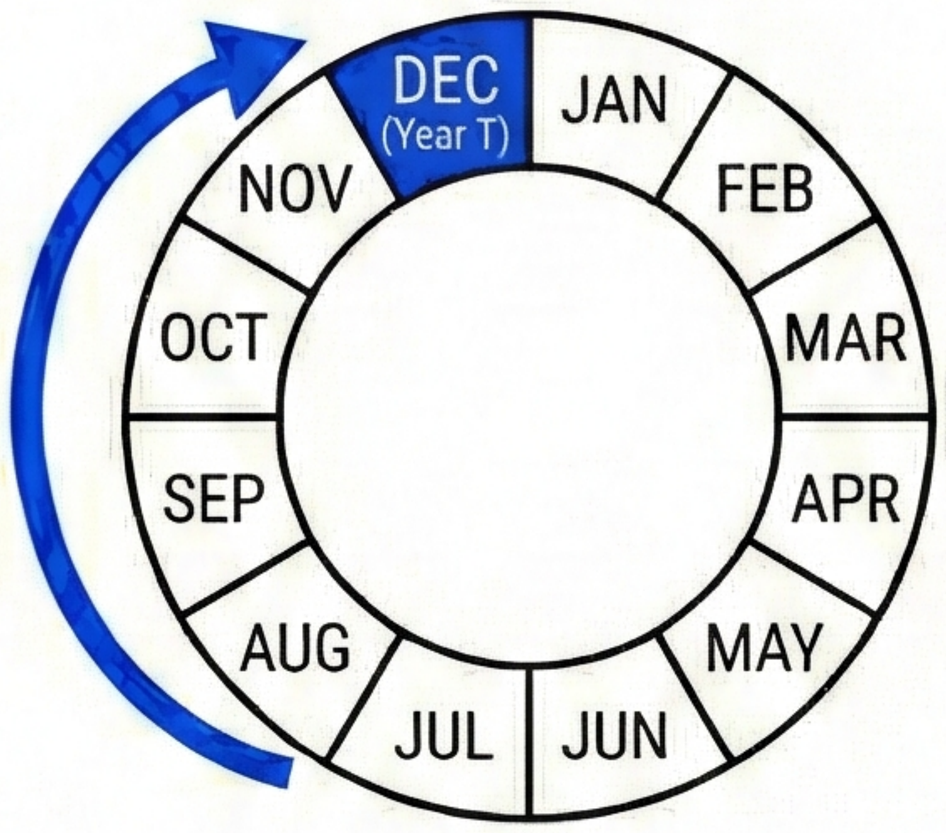
SEASONAL NAIVE MODEL: MONTHLY TIME SERIES FORECASTING

CORE PRINCIPLE: CYCLIC REPETITION

Forecast = Value from same month in the last year

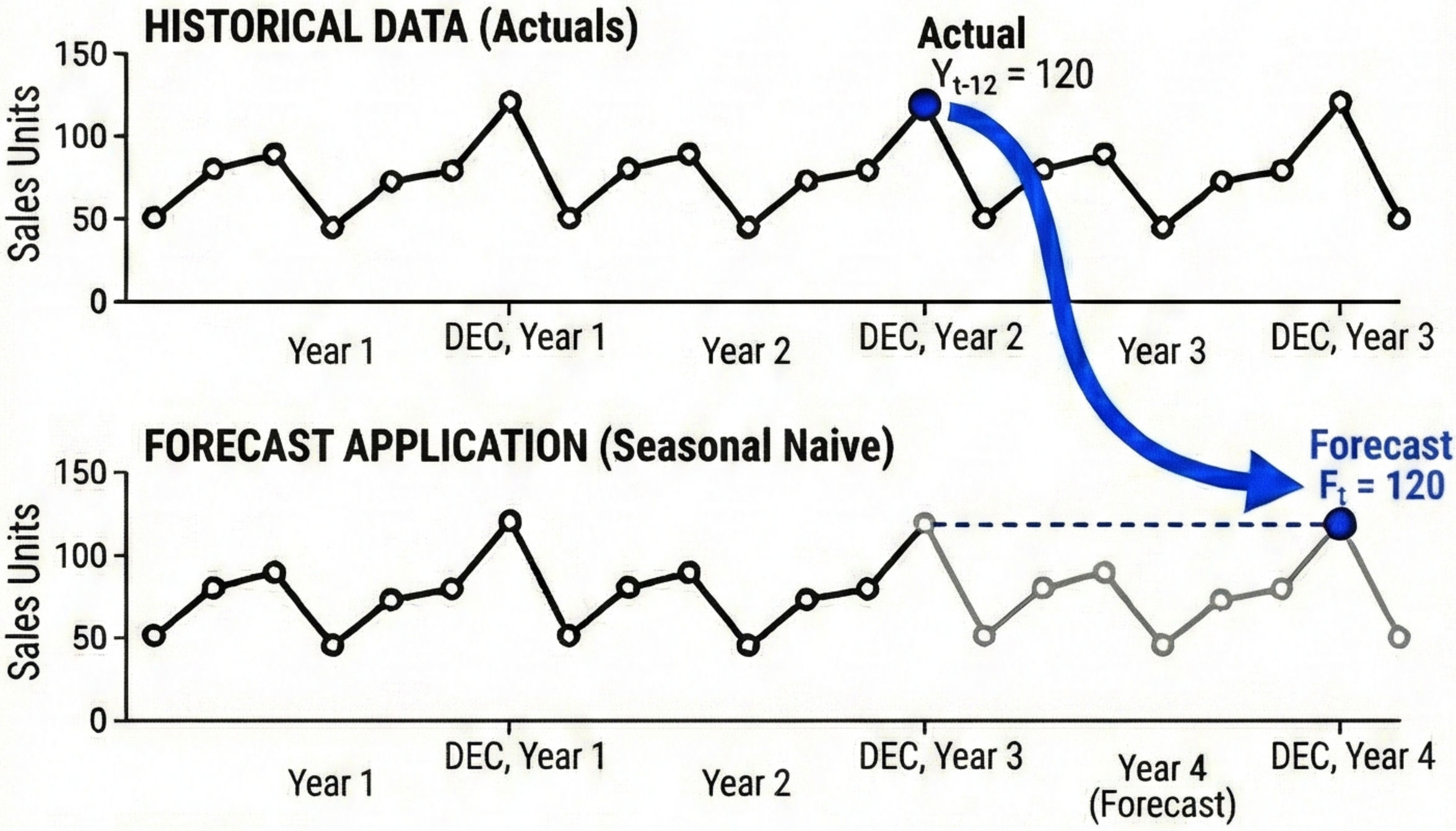


MATHEMATICAL RULE

$$F_t = Y_{t-m}$$

- F_t: Forecast at time t
- Y_{t-m}: Actual value at time (t-m)
- m: Seasonal period (e.g., m=12 for monthly)

WORKED EXAMPLE: MONTHLY SALES DATA



KEY CHARACTERISTICS & LIMITATIONS

- Simple baseline method
- Does not require parameter estimation
- Assumes perfect seasonal repetition
- Ignores trend changes and irregular fluctuations (Limitation)
- Lagged by one full season (Limitation)

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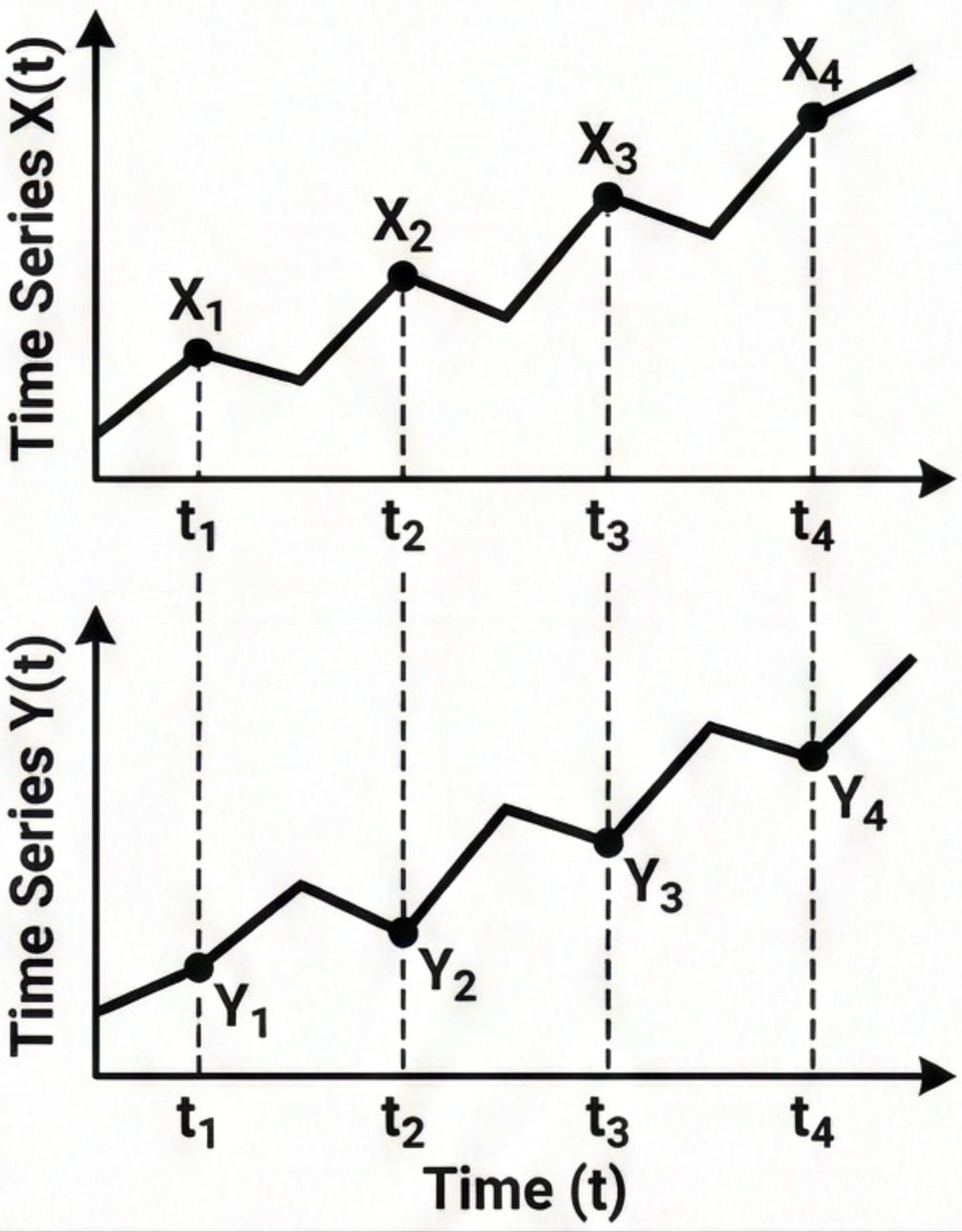
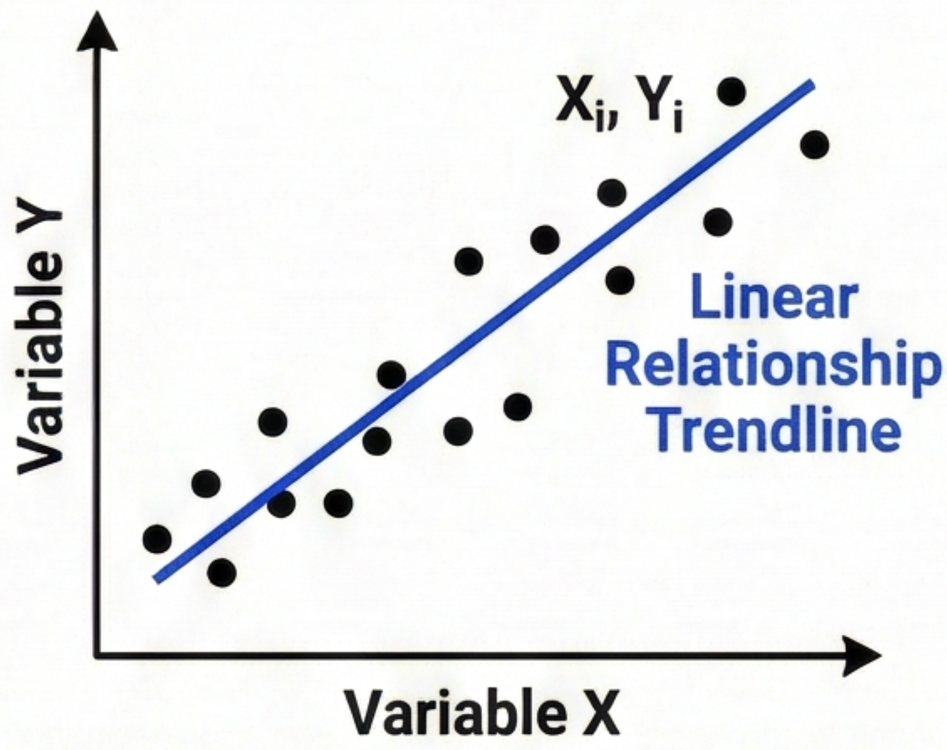
PEARSON CORRELATION FOR TIME SERIES FORECASTING

1. TIME SERIES DATA (INPUT)



Paired Observations

2. PEARSON CORRELATION (r)

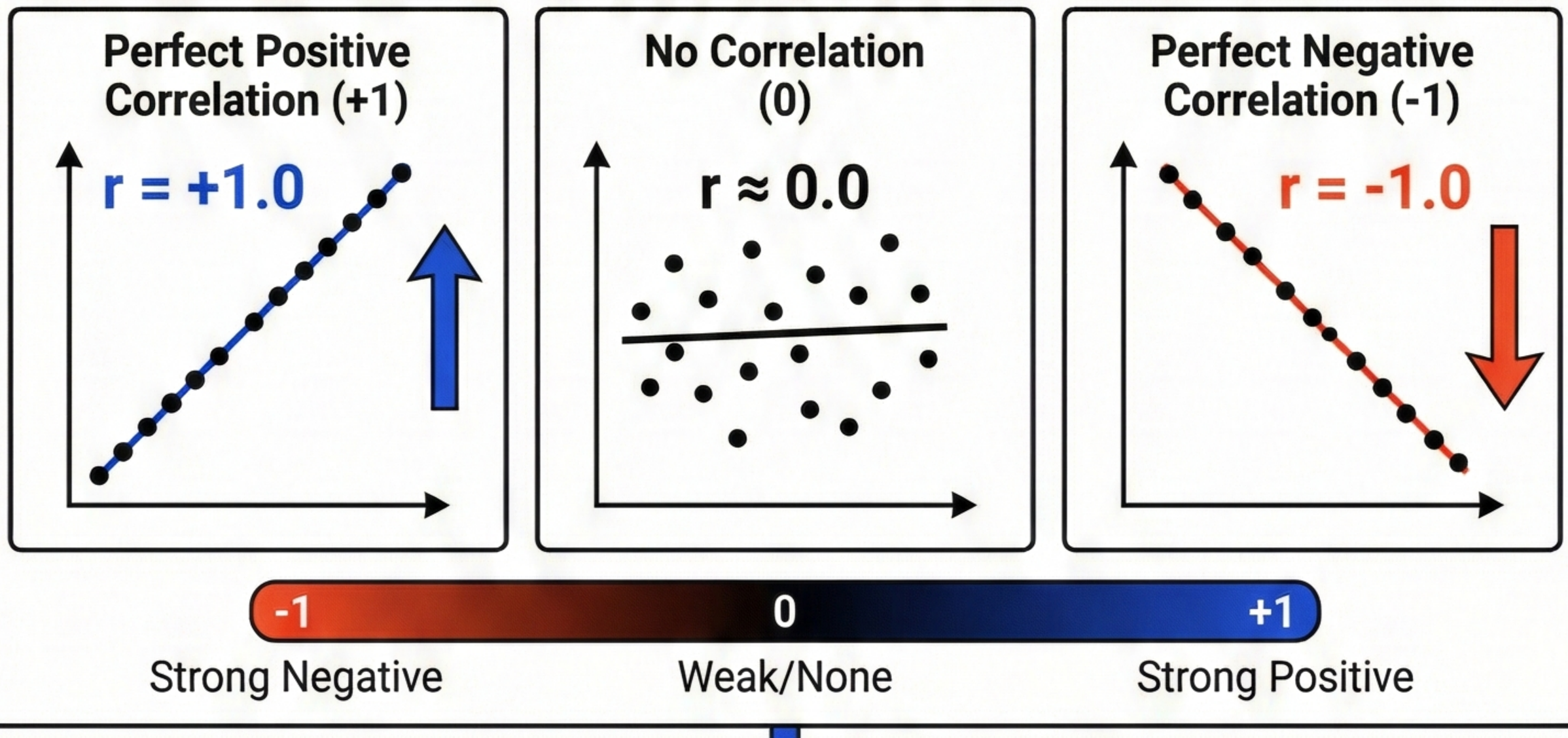


Pearson's **r** measures the strength and direction of a linear association between two continuous variables.

$$r = \frac{\sum[(X_i - \bar{X})(Y_i - \bar{Y})]}{\sqrt{\sum(X_i - \bar{X})^2} \cdot \sqrt{\sum(Y_i - \bar{Y})^2}}$$

Calculate **r**

3. CORRELATION STRENGTH & DIRECTION



Interpret & Select

4. FORECASTING APPLICATION

Assumption: Historical linear relationship continues

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COEFFICIENT OF DETERMINATION (R^2) IN TIME SERIES FORECASTING

Quantifying the Proportion of Variance Explained by a Forecasting Model

MODULE 1: CORE CONCEPT & DEFINITION

THE METRIC: MODEL FIT & EXPLANATORY POWER

0.0
(No Variation Explained)

Range of R^2 Values

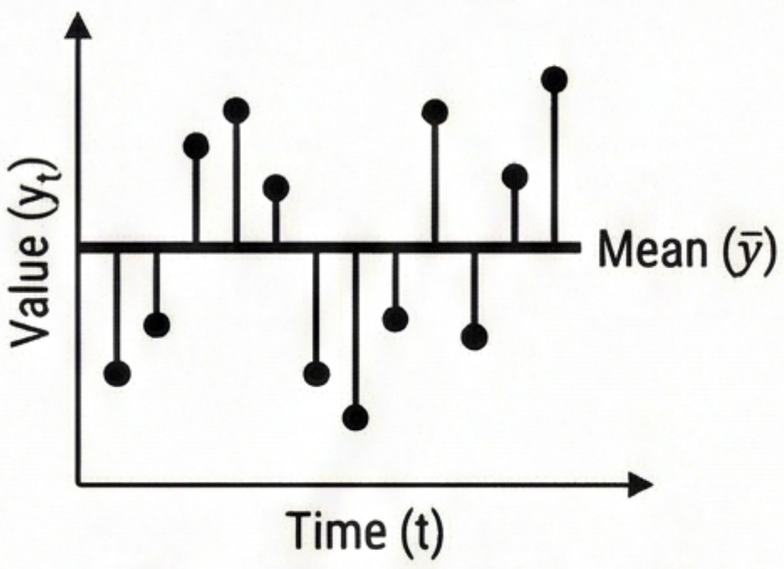
1.0
(Perfect Variation Explained)

R^2 measures how well the forecasting model's predictions approximate the real data points. It indicates the strength of the relationship between time and the observed variable.

MODULE 2: VISUALIZING EXPLAINED VARIANCE (The "Decomposition")

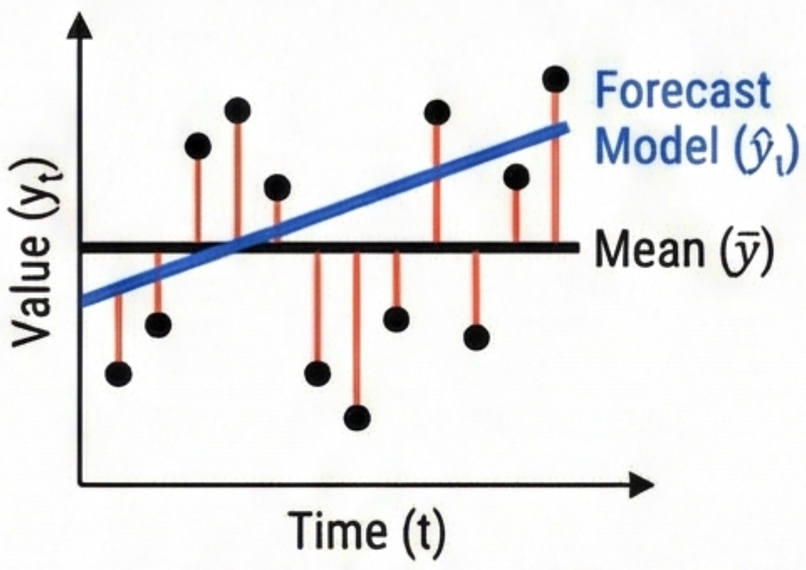
BREAKING DOWN VARIABILITY: TOTAL vs. EXPLAINED

Total Variation (TSS)



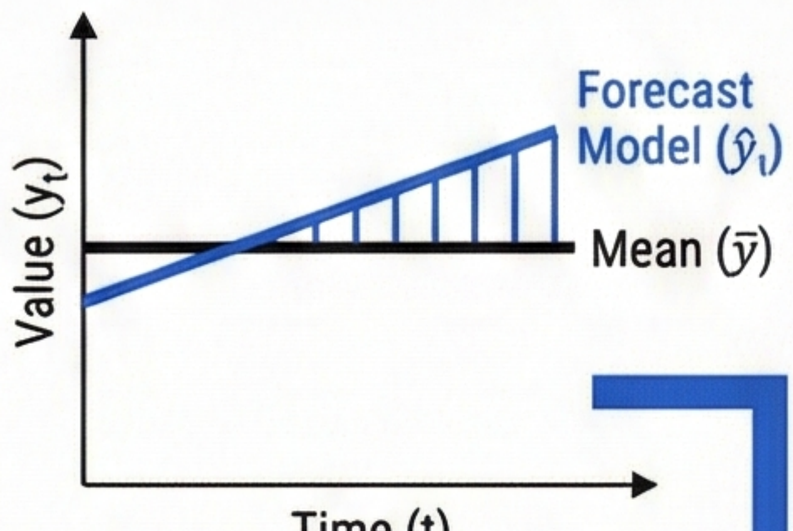
TSS = Total Sum of Squares
(Variation from Mean)

Unexplained Variation (RSS)



RSS = Residual Sum of Squares
(Prediction Errors)

Explained Variation (ESS)



ESS = Explained Sum of Squares
(Variation captured by Model)

MODULE 3: THE FORMULA (A Deconstructed View)

THE CALCULATION MECHANISM: A RATIO OF VARIANCES

$$R^2 = 1 - \left(\frac{\text{RSS}}{\text{TSS}}\right)$$

$$R^2 = \frac{\text{ESS}}{\text{TSS}}$$

Total Variation (TSS)
$$\sum (y_t - \bar{y})^2$$
The baseline variability in the historical data.

Unexplained Variation (RSS)
$$\sum (y_t - \hat{y}_t)^2$$
The variability NOT captured by the model (Errors).

MODULE 4: INTERPRETATION & LIMITATIONS (Management Insight)

INTERPRETING R^2: VALUE & CAUTION

PRACTICAL INTERPRETATION
(Value)

An R^2 of 0.85 means the forecasting model explains **85%** of the historical variation in the data.

It's a measure of goodness-of-fit on *past* data.

CRITICAL LIMITATIONS
(Caution)

R^2 does **NOT** guarantee future forecast accuracy.
A high R^2 can result from **overfitting** the past data, leading to poor future performance.
It also assumes a stationary relationship.

Alert: Always evaluate out-of-sample forecast errors (e.g., MAE, RMSE) alongside R^2.

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R^2 FOR SEASONALITY DETECTION IN TIME SERIES

Using the Coefficient of Determination to Quantify the Strength of Recurring Patterns.

MODULE 1: CORE CONCEPT & DEFINITION

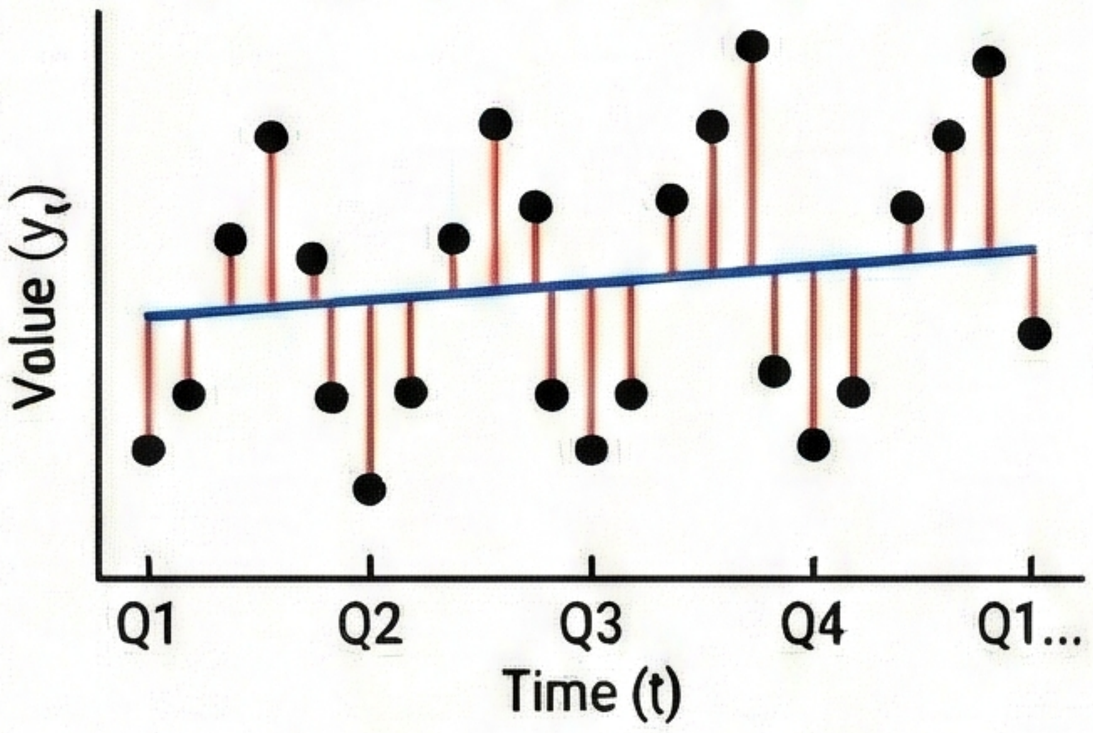
THE METRIC: SEASONAL VARIANCE EXPLAINED

In this context, **R^2** measures the proportion of total variance in the time series that is explained **solely by a seasonal model** (e.g., using seasonal dummy variables). **A high R^3 indicates a strong, consistent seasonal pattern.**

MODULE 2: THE MODELING MECHANISM (Visual Comparison)

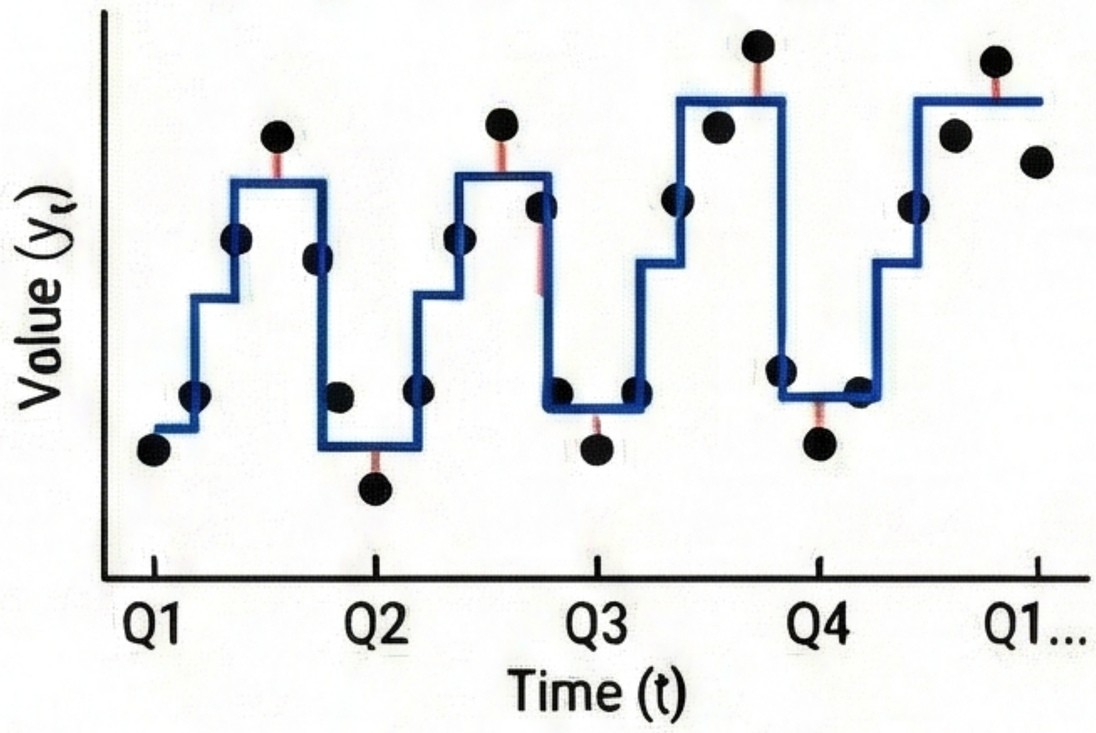
ISOLATING THE SIGNAL: COMPARING MODELS

Model A: Trend Only (No Seasonality)



Large Residuals (RSS).
R^2 is Low (e.g., ~0.10). Weak Signal.

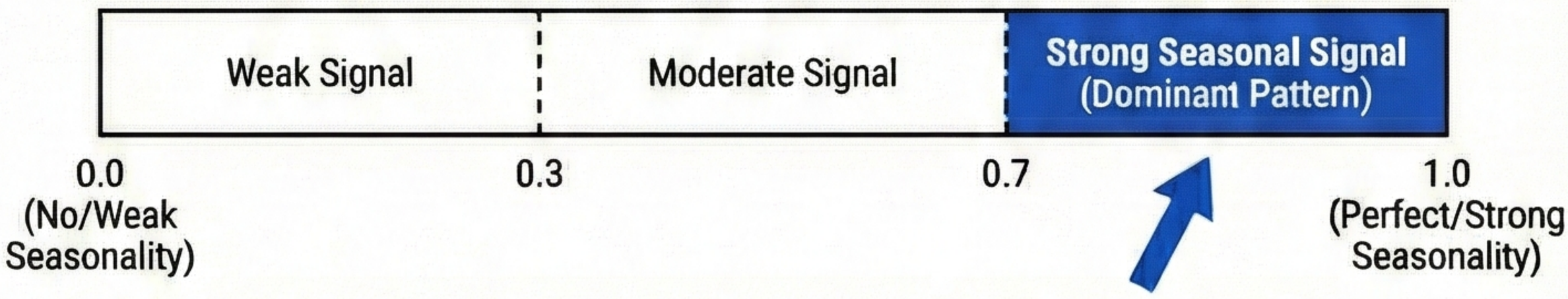
Model B: Seasonal Dummies Only



Small Residuals (RSS).
R^2 is High (e.g., ~0.90). Strong Signal.

MODULE 3: INTERPRETING THE R^2 SIGNAL (The Scale)

THE DIAGNOSTIC SCALE: STRENGTH OF PATTERN



Use R^2 from a seasonal-only model as a diagnostic. A high value confirms seasonality is a major driver of past variation, justifying the use of seasonal forecasting methods.

MODULE 4: CRITICAL LIMITATION & MANAGEMENT INSIGHT

MANAGEMENT ALERT: DIAGNOSIS VS. FORECAST

DIAGNOSTIC VALUE (Insight)

High R^2 confirms that seasonality exists and is consistent in the historical data. It's a green light to proceed with seasonal modeling techniques.

FORECASTING TRAP (Alert)

High R^2 does **NOT** guarantee accurate *future* forecasts. The pattern could change or break. It only describes the pest fit. Always validate with out-of-sample testing.

Alert: R^2 measures past fit, not future predictive power.

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