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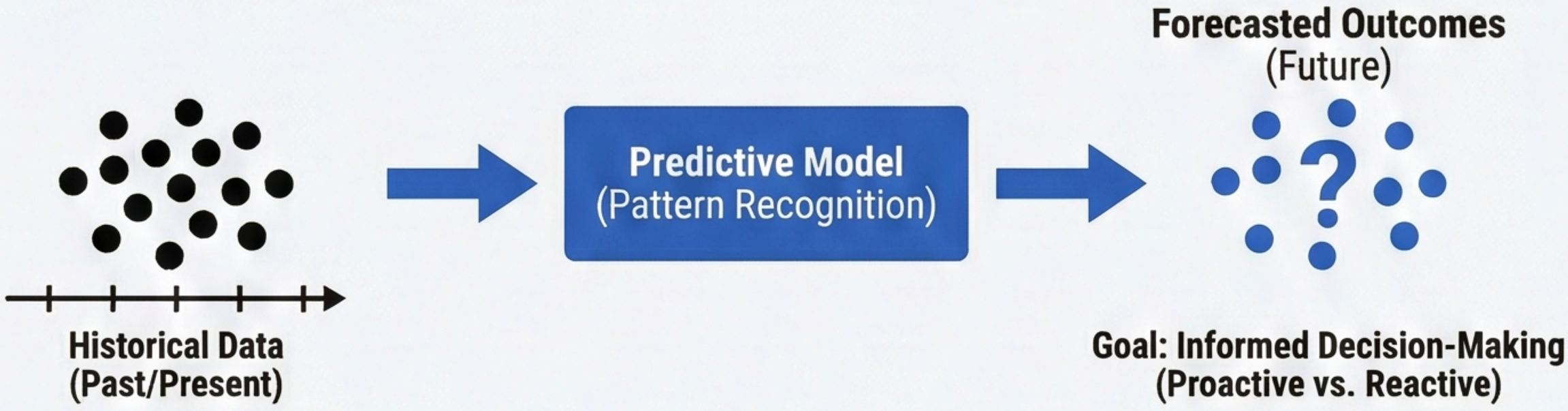
PREDICTIVE STATISTICS: FORECASTING FOR MANAGEMENT DECISIONS

Using Historical Data to Model Future Outcomes & Reduce Uncertainty.

MODULE 1: CORE CONCEPT & GOAL

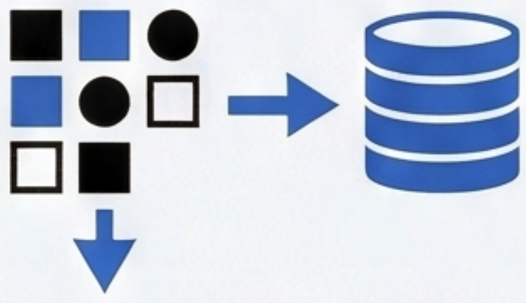
THE CONCEPT: FROM HINDSIGHT TO FORESIGHT



MODULE 2: THE PREDICTIVE PROCESS (THE ENGINE)

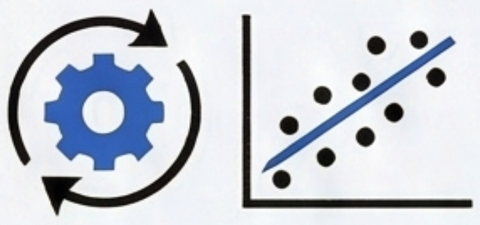
THE PROCESS: DATA TO INSIGHT FLOW

1. Data Collection & Preparation



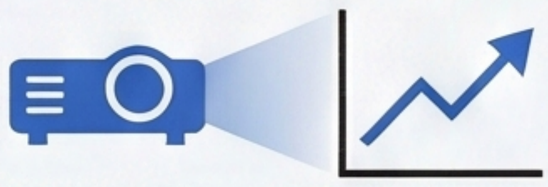
Gather relevant historical data, clean, and structure for analysis.

2. Model Training (Learning Patterns)



Apply algorithms (e.g., Regression) to learn relationships and and trends from the data.

3. Prediction (Generating Forecasts)

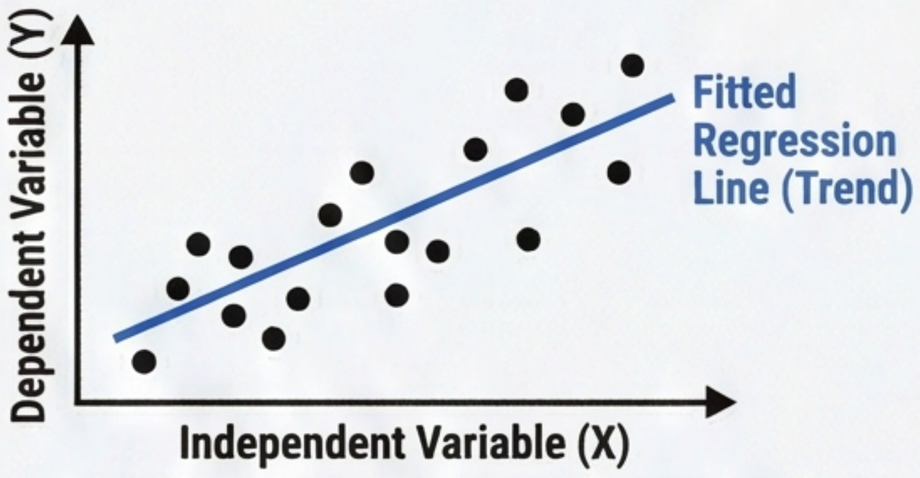


Use the trained model to generate estimates for unknown future values.

MODULE 3: KEY TECHNIQUES (MANAGEMENT TOOLS)

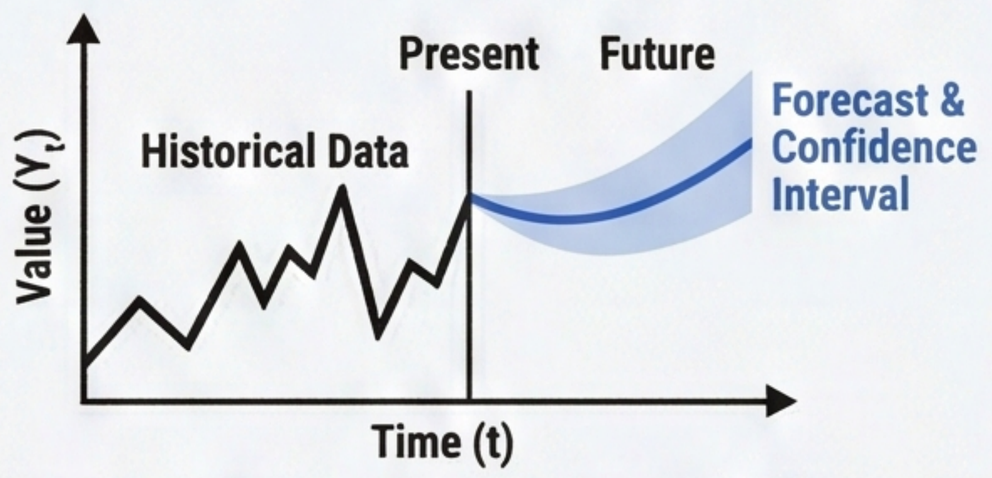
COMMON TECHNIQUES: MODELING APPROACHES

REGRESSION ANALYSIS (Relationships)



Quantifies the relationship between variables to predict a continuous outcome (e.g., Sales based on Ad Spend).

TIME SERIES FORECASTING (Trends/Cycles)

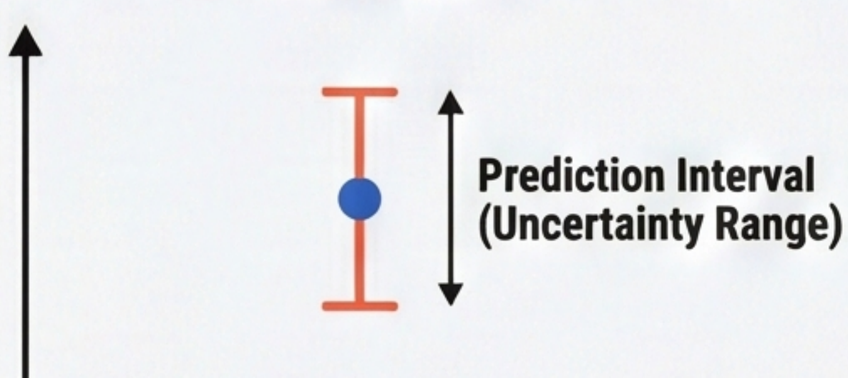


Uses past values over time to predict future values, accounting for seasonality and trend (e.g., Monthly Revenue).

MODULE 4: CRITICAL CONSIDERATIONS (RISK & LIMITATIONS)

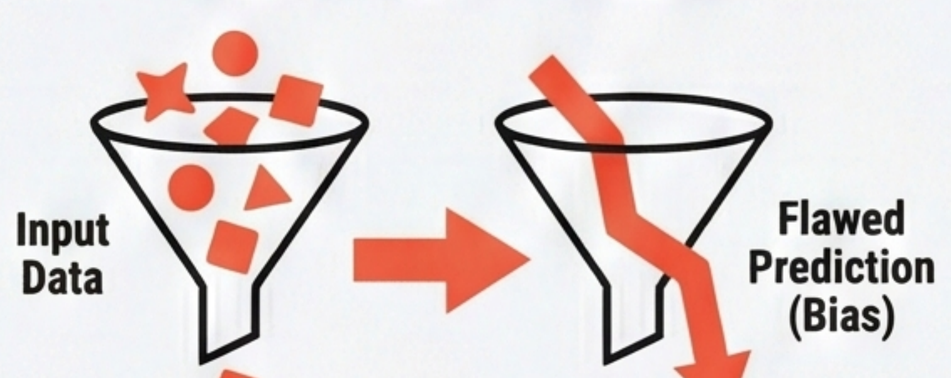
MANAGEMENT INSIGHT: UNCERTAINTY & BIAS

MODEL UNCERTAINTY & ERROR



Vermilion Alert: Forecasts are probabilistic, not certain. Always consider the margin of error and confidence levels.

DATA QUALITY & BIAS



Vermilion Alert: "Garbage In, Garbage Out". Biased or incomplete historical data will lead to inaccurate and misleading predictions.

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CONFIDENCE INTERVALS IN TIME SERIES FORECASTING

Quantifying Uncertainty for Future Planning & Risk Management

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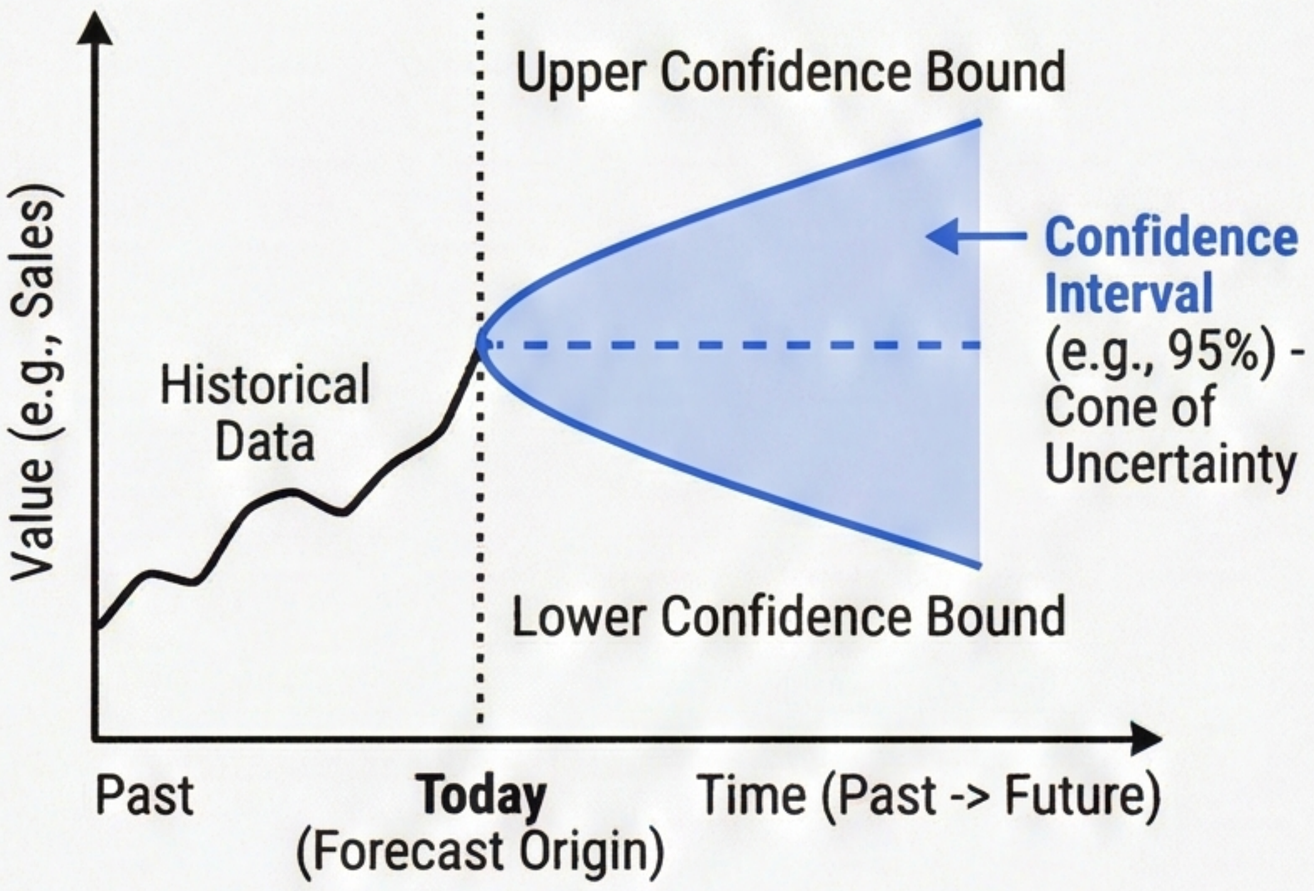
MODULE 1: CORE VISUAL - THE "CONE OF UNCERTAINTY"

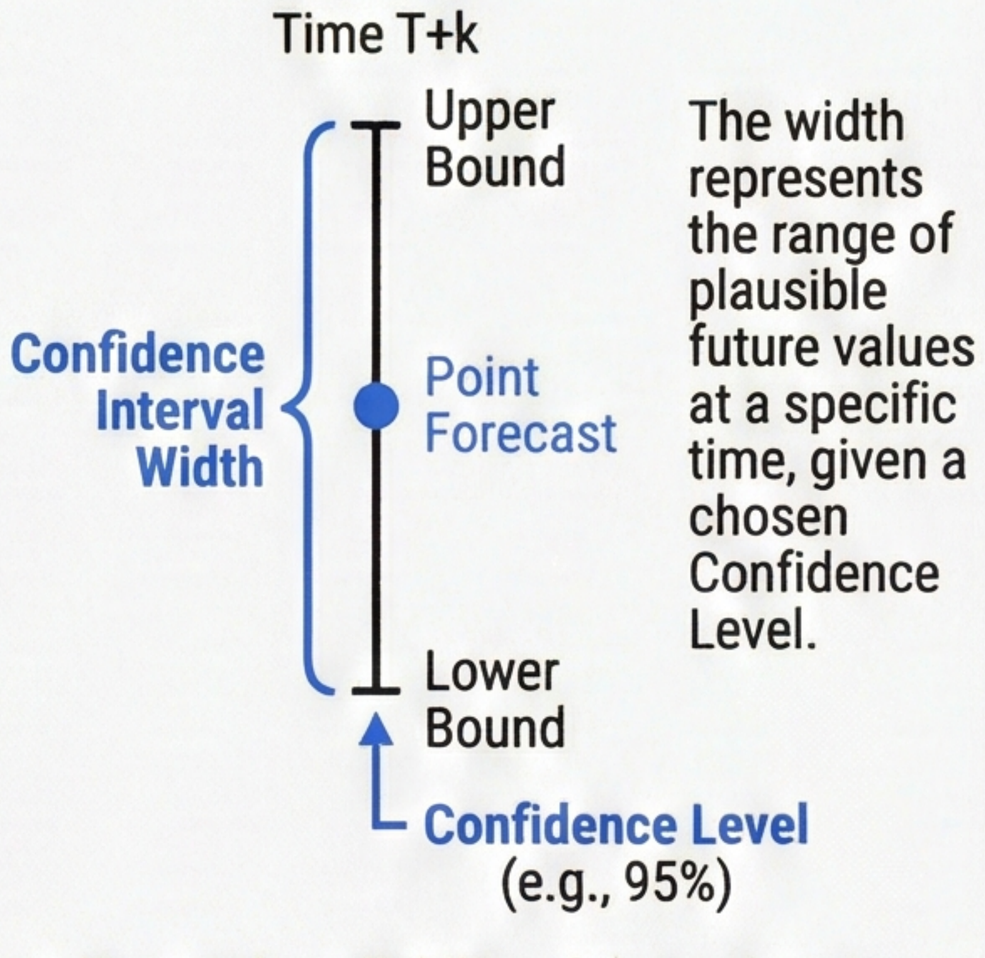
VISUALIZING FUTURE UNCERTAINTY



The interval widens over time, reflecting increasing uncertainty further into the future.

MODULE 2: ANATOMY OF THE INTERVAL

INTERVAL COMPONENTS & MEANING



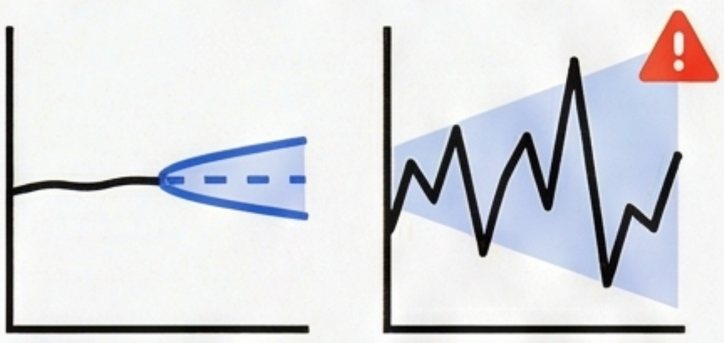
The width represents the range of plausible future values at a specific time, given a chosen Confidence Level.

Indicates the reliability of the estimation procedure, not a probability for a single forecast.

MODULE 3: KEY DRIVERS OF UNCERTAINTY (Management Levers)

FACTORS INFLUENCING INTERVAL WIDTH

HISTORICAL VOLATILITY

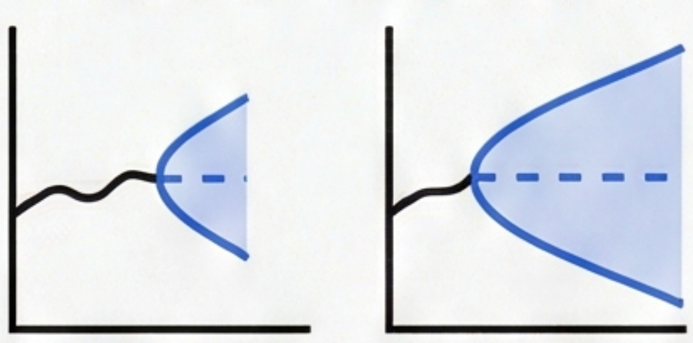


Low Volatility — High Volatility

Higher Volatility

→ **Wider Interval**
(More Risk)

FORECAST HORIZON

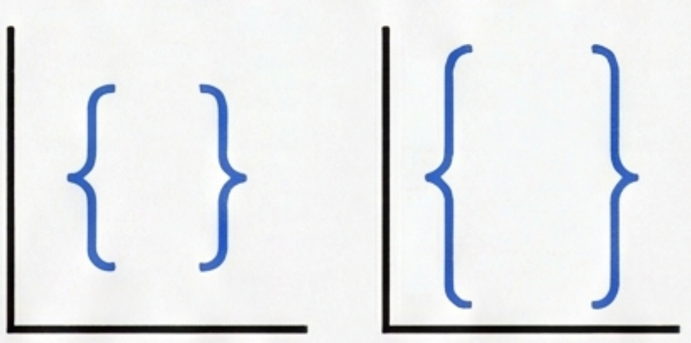


Short Horizon — Long Horizon

Longer Horizon

→ **Wider Interval**
(Cumulative Uncertainty)

CONFIDENCE LEVEL



90% Level — 99% Level

Higher Confidence Level

→ **Wider Interval**
(Greater Certainty Requires Larger Range)

MODULE 4: INTERPRETATION & MISINTERPRETATION (Management Insight)

CORRECT vs. INCORRECT INTERPRETATION

✓ CORRECT INTERPRETATION
(Procedural Reliability)

In repeated application of this forecasting method, **95%** **of the generated intervals would contain the true future value.**

It's about the method's long-term performance.

✗ INCORRECT INTERPRETATION
(Probabilistic Fallacy)

There is a **95% probability that the true future value lies within this *specific* calculated interval.**

⚠ **Alert:** This is a common fallacy. The true value is fixed, not random.

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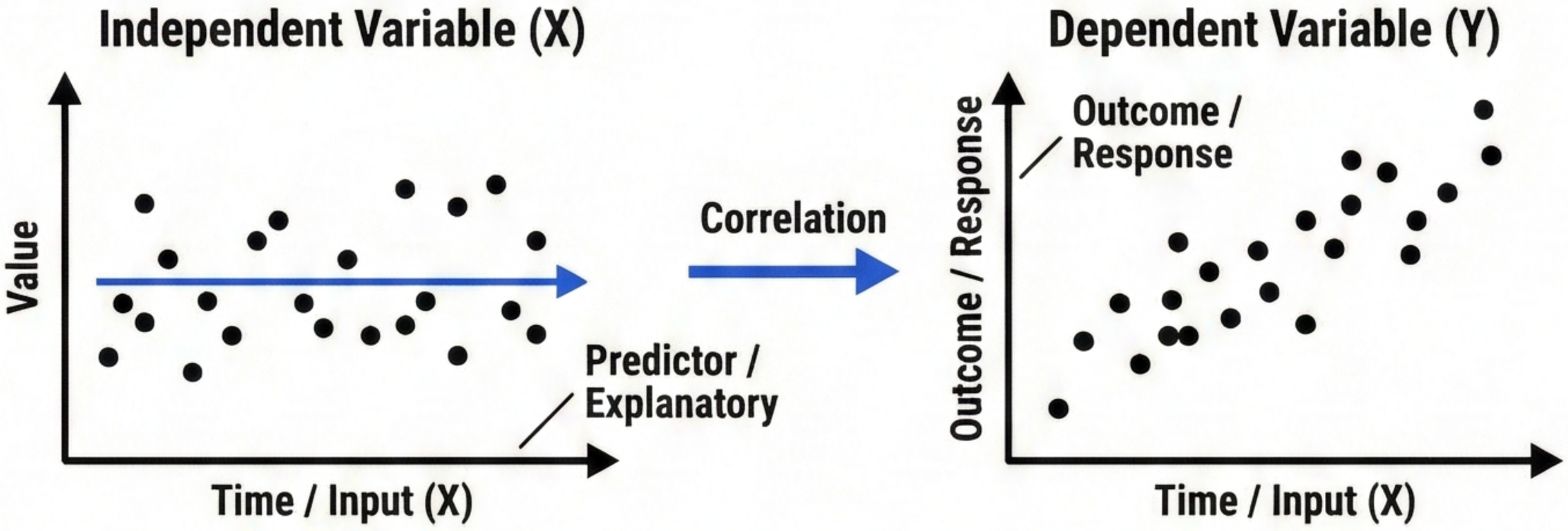
LINEAR REGRESSION FORECASTING

1. DATA INPUT: VARIABLES & RELATIONSHIP



2. THE REGRESSION MODEL (EQUATION)

$$Y = \alpha + \beta X + \varepsilon$$

Predicted Value (Dependent)

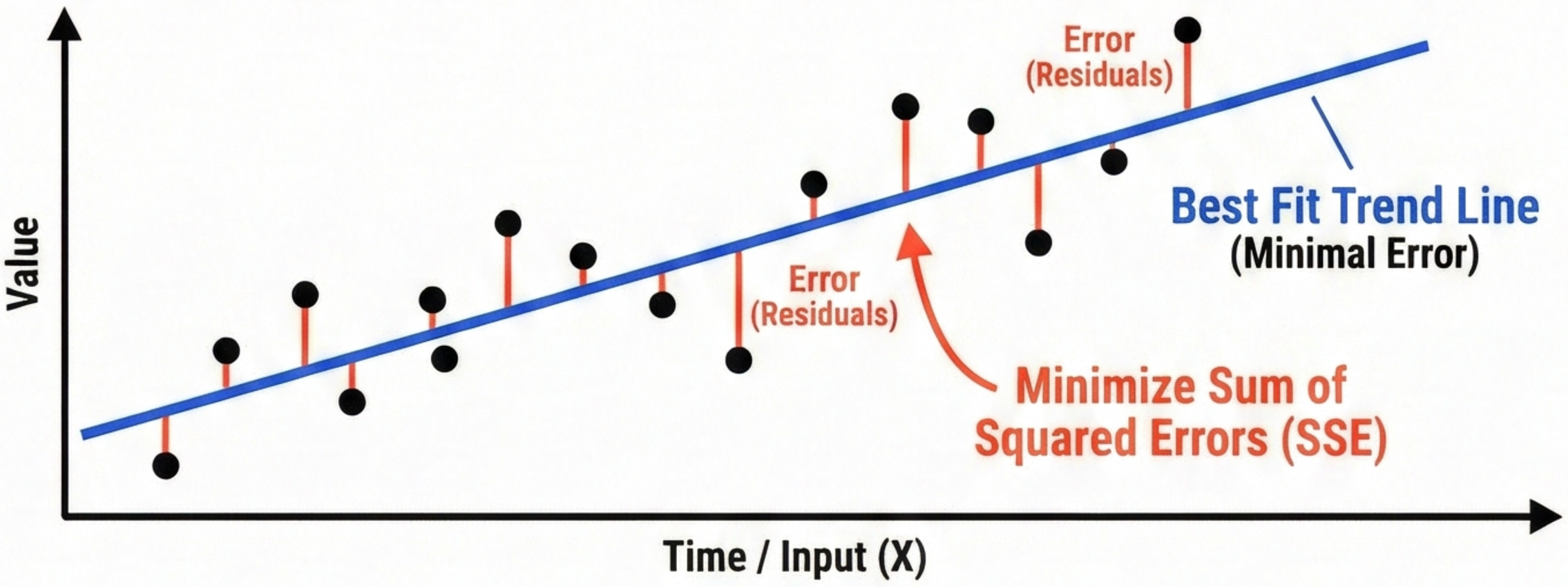
Intercept (Constant, Y-value when X=0)

Slope (Coefficient, Rate of change in Y for unit change in X)

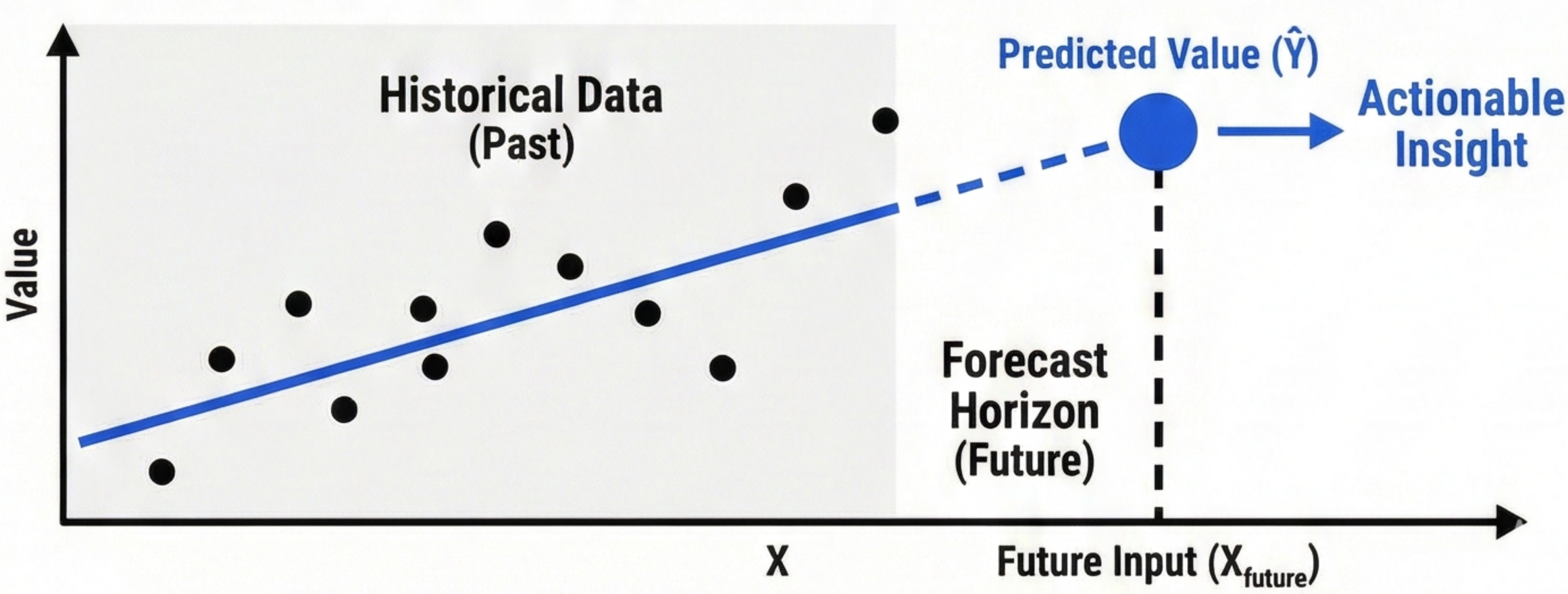
Input Value (Independent)

Error Term (Random variation)

3. FINDING THE "BEST FIT" LINE (LEAST SQUARES)



4. FORECASTING OUTPUT (PREDICTION)



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NAIVE MODEL: MONTHLY TIME SERIES FORECASTING

Principle: The forecast for the next month is simply the value observed in the current month (t+1 forecast = t actual).

MATHEMATICAL NOTATION

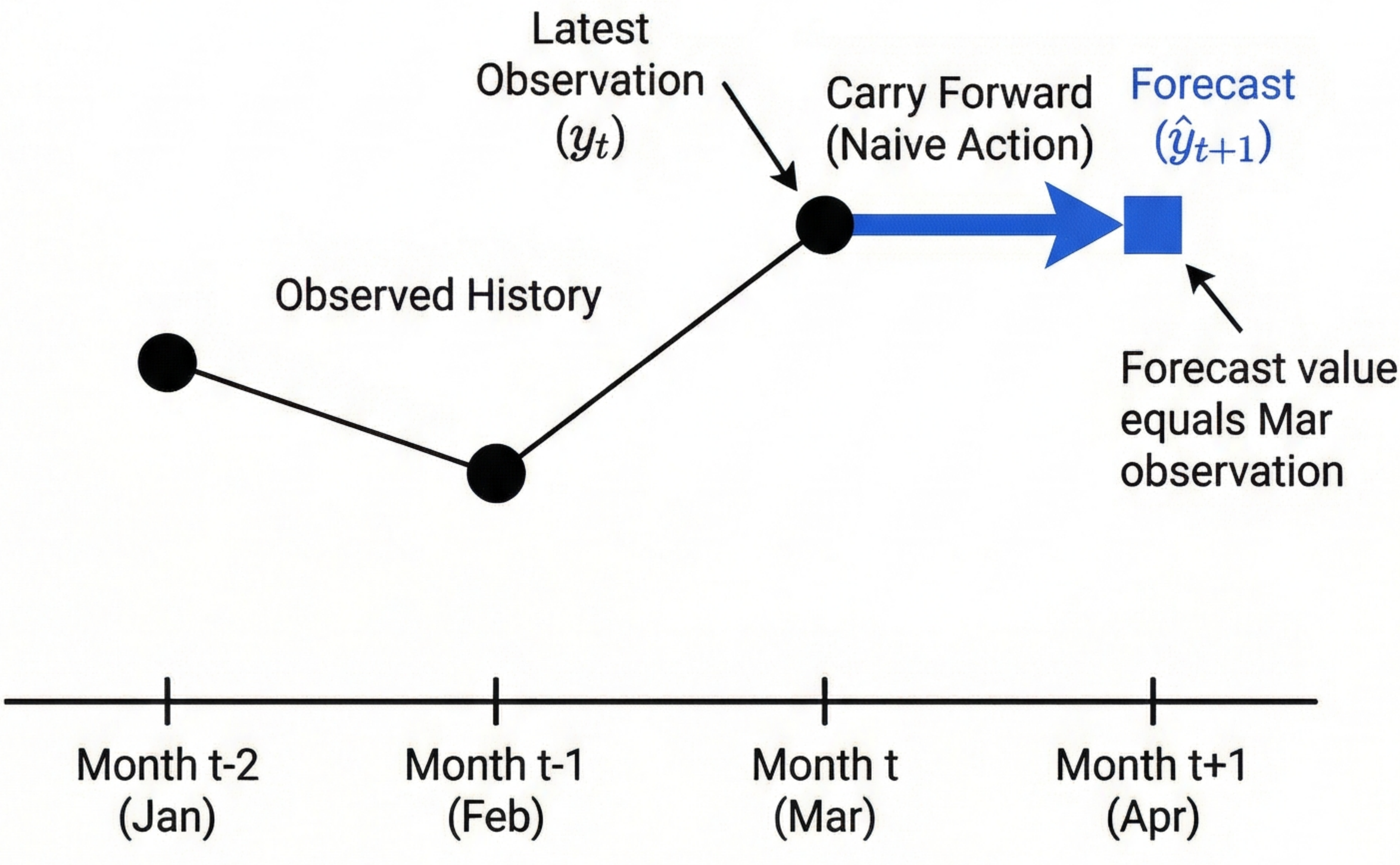
$$\hat{y}_{t+1} = y_t$$

Forecast for next month

Is equal to

Actual observation of current month

VISUAL PROCESS: STEP-BY-STEP DEMONSTRATION



KEY CHARACTERISTICS & USAGE

ASSUMPTION: No trend or seasonality. Data is expected to fluctuate around a constant level.

ROLE: Serves as a baseline benchmark. More complex models must outperform this simple rule.

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