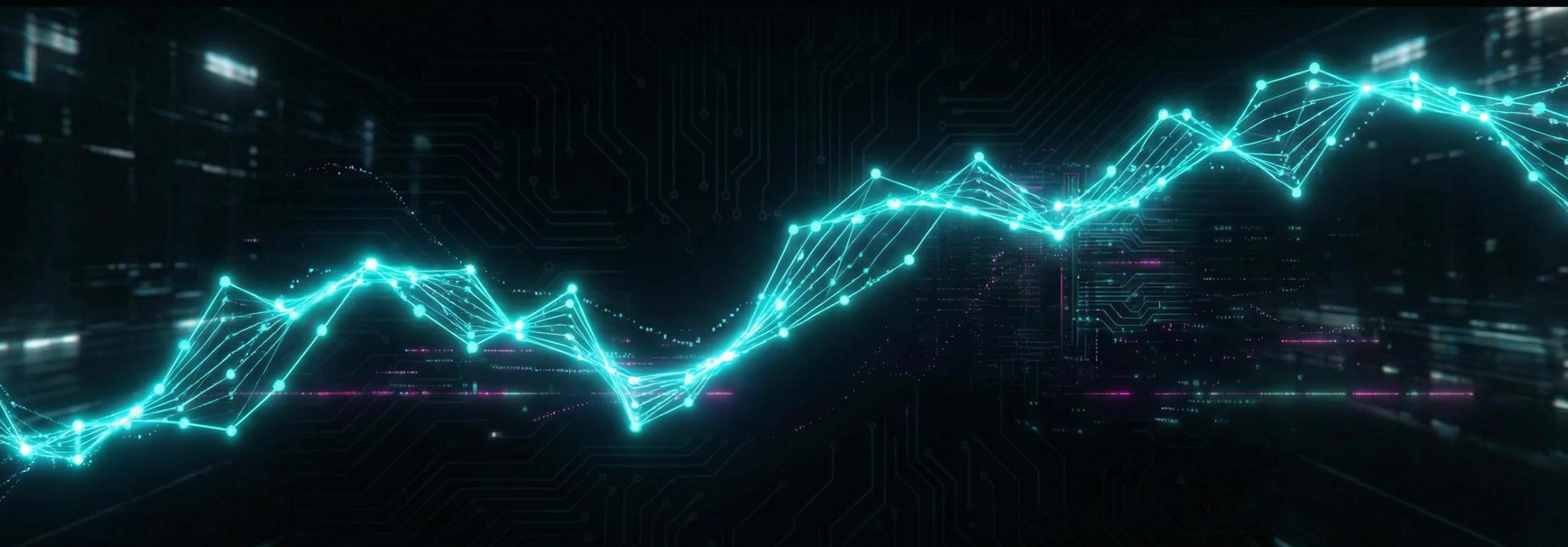


Time Series Mining: Finding Stories in Your Data

Chapter 1 – Time Series Foundations



From Wrangling to **Mining**

The Next Step



You've mastered the cleanup

Now we find the **gold**

Moving from "**How?**" to "**Why?**"

The Big Picture: Why Time is Different

Order Matters: “If you shuffle the rows, you destroy the meaning.”

CROSS-SECTIONAL DATA: INDEPENDENT



The Analogy:
A shuffled playlist.



TIME SERIES DATA: DEPENDENT



The Analogy:
A medical chart.

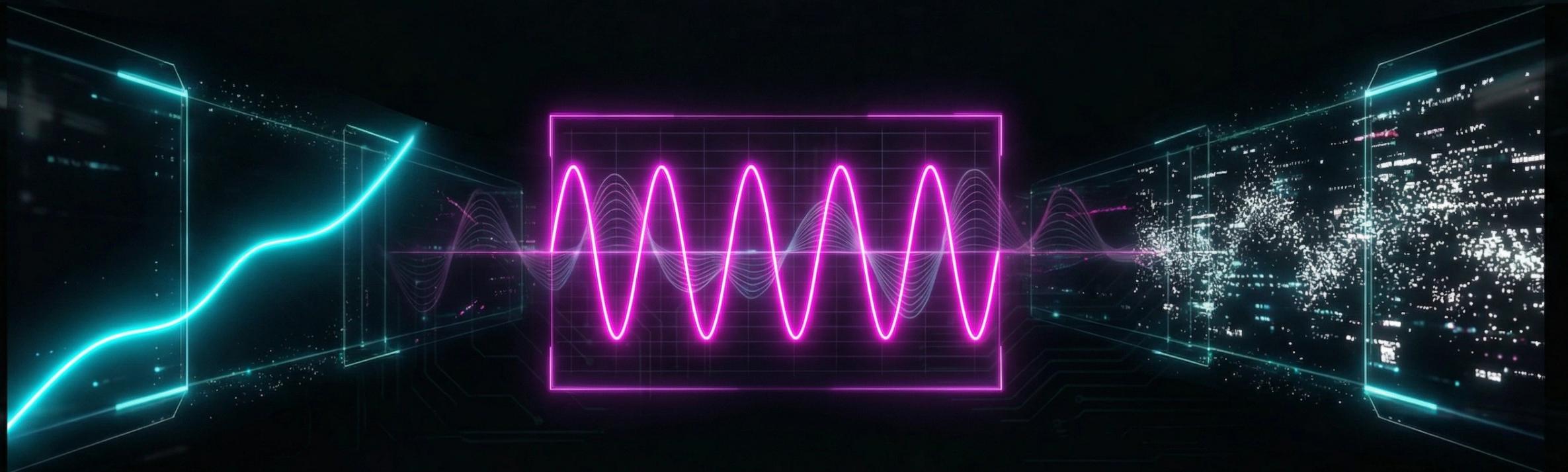


The Three Forces

TREND

SEASONALITY

RESIDUALS



Case Study: The Wynwood Gallery



The Problem: “Chaos.”
Unpredictable crowds,
impossible staffing.

The Data: 3 Years of
Foot Traffic

The Insight: “It’s not
random. It’s a rhythm.”

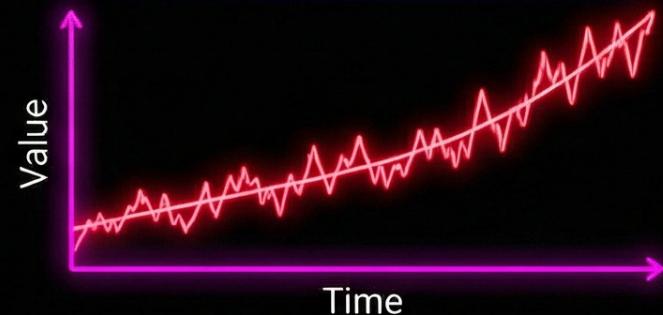
Stationarity: The Treadmill Analogy

Stationary: Constant Speed (6.5 mph)



Why It Matters: Models need stability to learn.

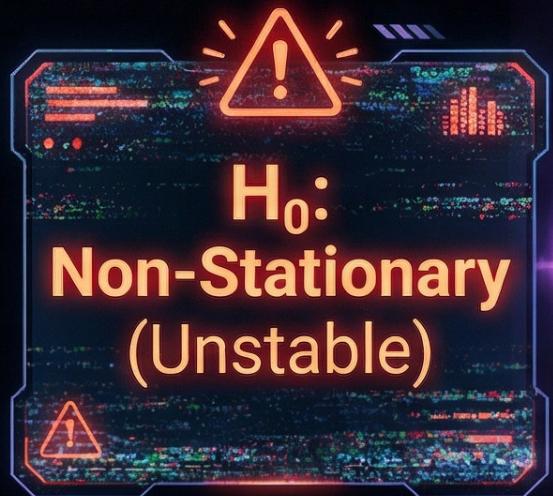
Non-Stationary: Accelerating Speed (Danger!)



Why It Matters: Models struggle with shifting data patterns.

The Augmented Dickey-Fuller (ADF) Test

Your Data's Building Inspector



Null Hypothesis (H_0)



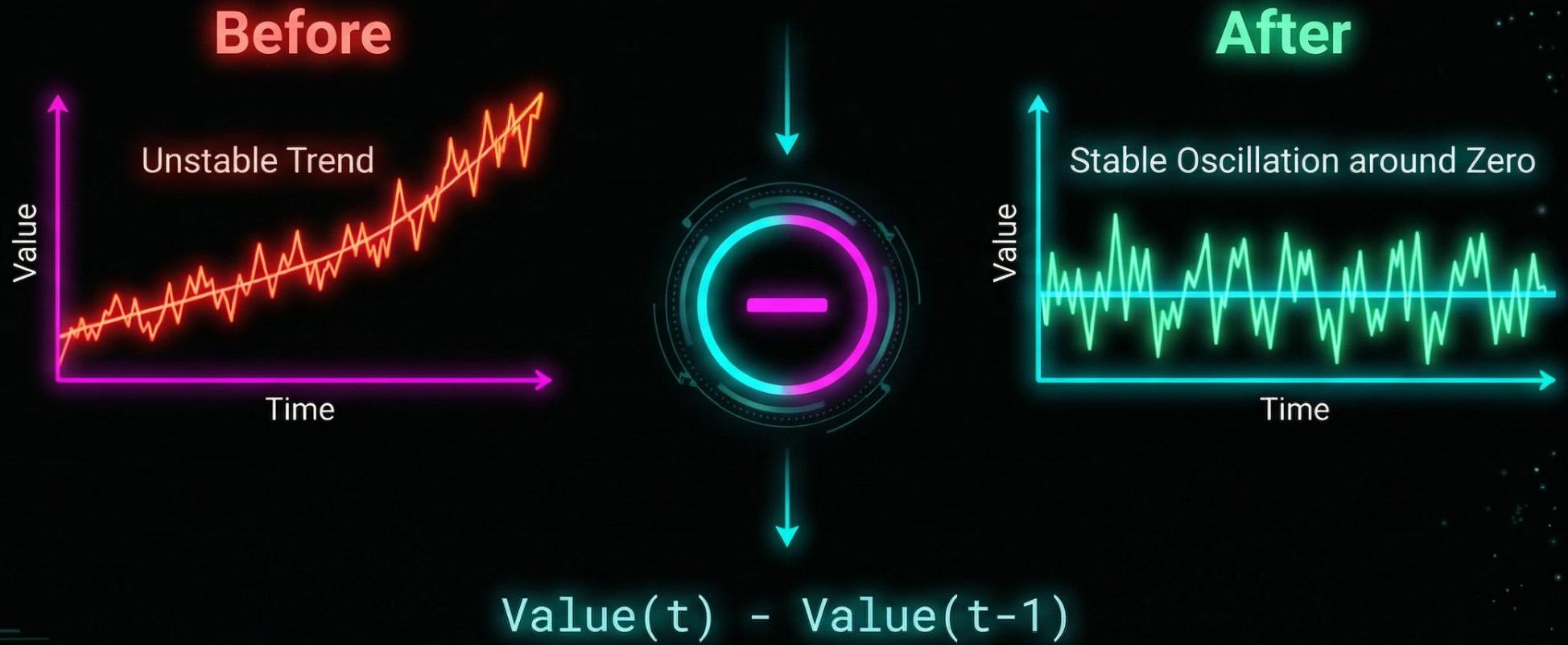
The Rule

p-value: 0.042



Technique: Differencing

Making Data Stationary



The Fix: Subtract the Previous Value ($t - (t-1)$)

The Result: Stable Data (Stationary)

Resampling & Rolling Windows

Adjusting the Resolution

- **Resampling:**
Changing the frequency
(Daily → Monthly)
- **Rolling Windows:**
Smoothing out the noise

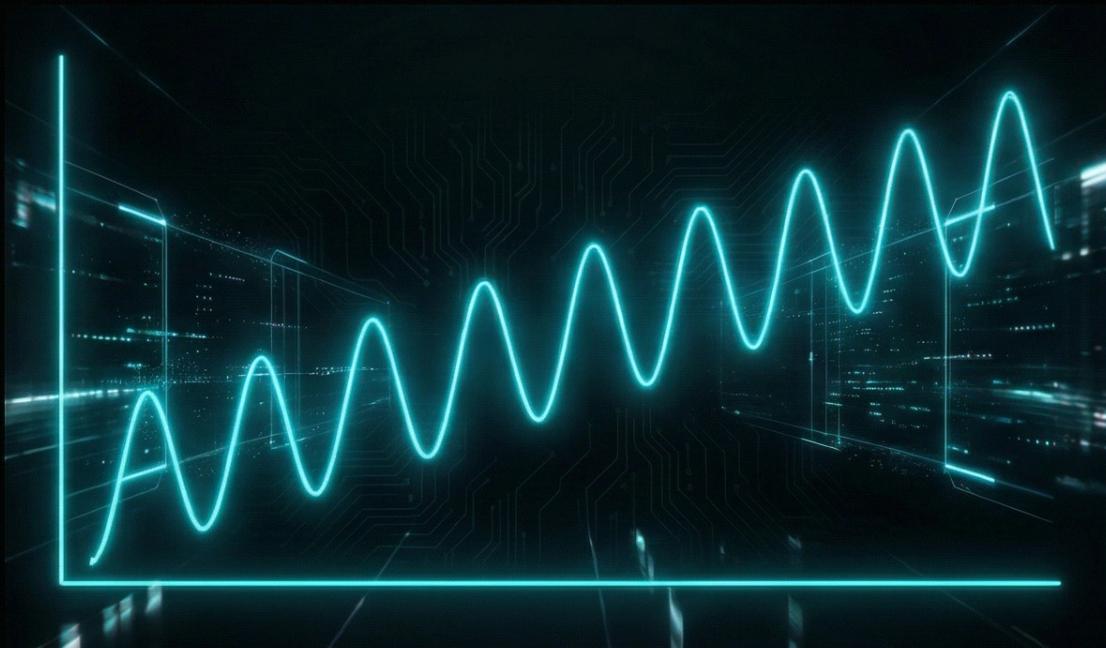
"Noise-Canceling
Headphones for
Your Data"



SEASONAL DECOMPOSITION MODELS

Additive Model

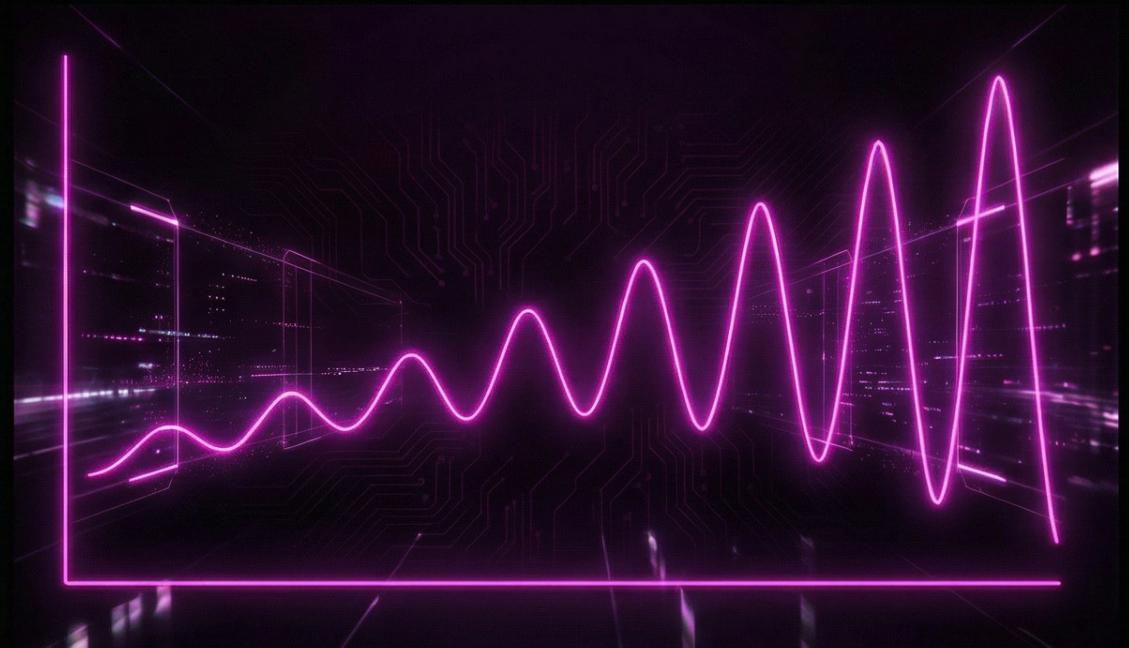
Use when seasonal swings are constant.



$$y = \text{Trend} + \text{Seasonal} + \text{Residual}$$

Multiplicative Model

Use when seasonal swings grow with the trend.



$$y = \text{Trend} * \text{Seasonal} * \text{Residual}$$

Visualizing the Decomposition Output

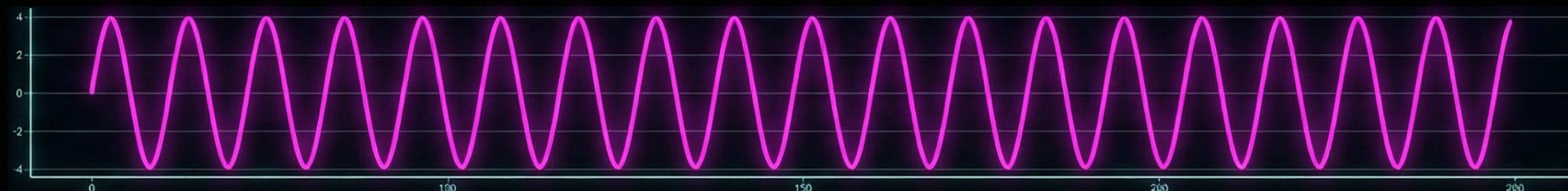
Observed



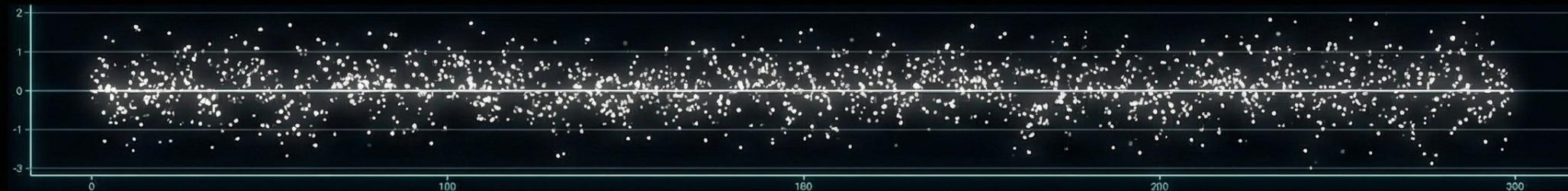
Trend



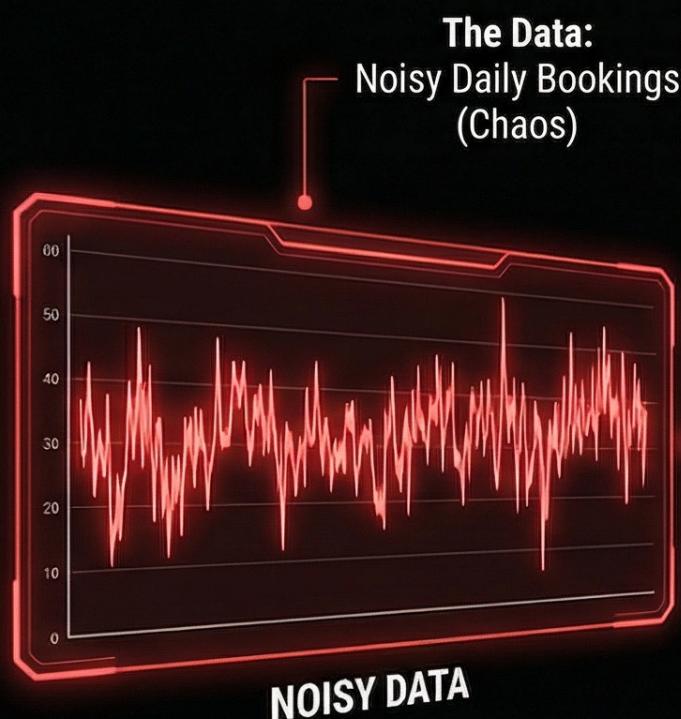
Seasonal



Residual

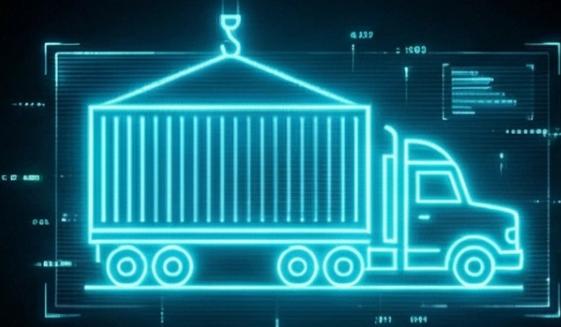


Putting It All Together: The Collins Ave Hotel



The Strategy: Dynamic Pricing & Promos

The “So What?”: Your Skills in the Real World



Logistics

Inventory Forecasting (Doral)



Hospitality

Dynamic Pricing (Miami Beach)



Finance

Risk Models (Brickell)



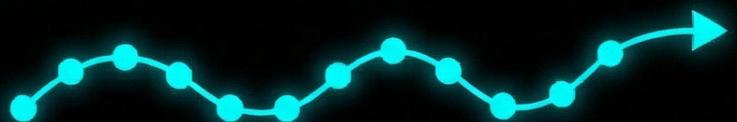
Marketing

Campaign ROI (Cruise Lines)

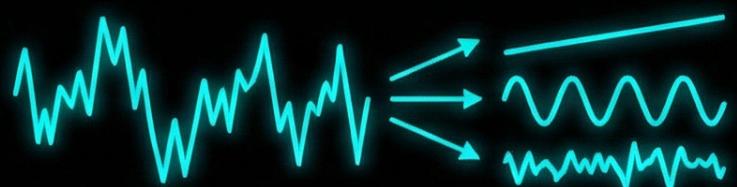
Key Takeaways & What's Next

TAKEAWAYS

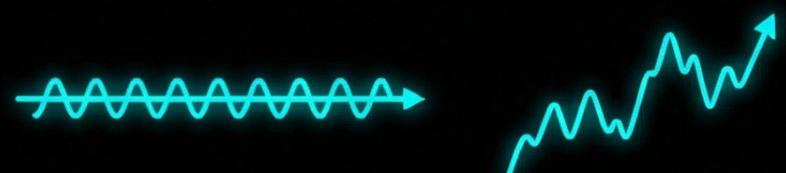
- Time Series is Special (Order Matters)



- Decomposition Reveals the Signal



- Stationarity is the Goal



NEXT WEEK

- Forecasting the Future



- Tools: SARIMAX & Prophet