Statistics and Data Analysis
Unit 06 – Lecture 01: Time-series Concepts (Trend, Seasonality, Autocorrelation)

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https://github.com/tali7c/Statistics-and-Data-Analysis

Overview
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Components
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Autocorrelation
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Demo
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Summary
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Quick Links

Overview   Components   Autocorrelation   Exercises   Demo   Summary

Agenda

Learning Outcomes

- Define time series and why order matters

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- Identify trend, seasonality, and noise

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- Define time series and why order matters
- Identify trend, seasonality, and noise
- Explain autocorrelation (intuition)
- Explain why random shuffling breaks time series analysis

Components: Key Points

- Trend: long-term movement

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- Seasonality: repeating pattern

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- Trend: long-term movement
- Seasonality: repeating pattern
- Noise: irregular fluctuations

Autocorrelation: Key Points

- Correlation with past values

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- Important for AR/MA/ARIMA models

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- Correlation with past values
- Important for AR/MA/ARIMA models
- Shows persistence of shocks

Exercise 1: Order matters

Why should train/test split be chronological for time series?

Solution 1

- To avoid future-to-past leakage.

Exercise 2: Seasonality example

Give one seasonal pattern in campus data.

Solution 2

- Weekly cafe sales (weekday vs weekend), etc.

Exercise 3: Autocorr meaning

If lag-1 autocorrelation is strong positive, what does it suggest?

Solution 3

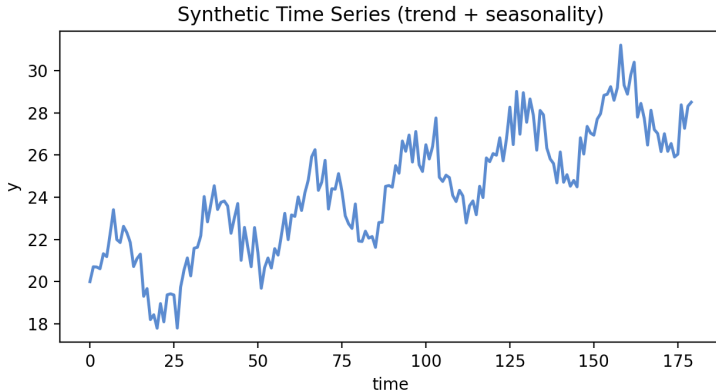- Values tend to persist from one step to next.

Mini Demo (Python)

Run from the lecture folder:

$$\texttt{python demo/demo.py}$$

Outputs:

- `images/demo.png`
- `data/results.txt`

Demo Output (Example)

Synthetic Time Series (trend + seasonality)

Summary

- Key definitions and the main formula.

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- How to interpret results in context.

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- Key definitions and the main formula.
- How to interpret results in context.
- How the demo connects to the theory.

Exit Question

In one sentence: what is seasonality and why does it matter for
forecasting?