

# Statistics and Data Analysis

## Unit 06 – Lecture 03: AR and MA Models

Tofik Ali

School of Computer Science, UPES Dehradun

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

# Quick Links

Overview

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MA

Exercises

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Summary

# Agenda

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6 Summary

# Learning Outcomes

- Explain  $AR(p)$  model idea

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- Explain MA(q) model idea

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- Explain AR(p) model idea
- Explain MA(q) model idea
- Differentiate AR vs MA intuition

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- Explain  $AR(p)$  model idea
- Explain  $MA(q)$  model idea
- Differentiate AR vs MA intuition
- Define white noise (basic)

# AR: Key Points

- Current value depends on past values



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- Current value depends on past values
- AR(1):  $x_t = c + \phi x_{t-1} + e_t$
- $\phi$  controls persistence

# AR: Key Formula

$$x_t = c + \phi x_{t-1} + \epsilon_t$$

# MA: Key Points

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- Current value depends on past shocks
- MA(1):  $x_t = \mu + e_t + \theta e_{t-1}$
- Captures short-term shock effects

# MA: Key Formula

$$x_t = \mu + \epsilon_t + \theta\epsilon_{t-1}$$

# Exercise 1: AR intuition

If  $\phi=0.8$  and last value is high (ignore noise), what happens next?



# Solution 1

- Next value tends to be high too.

## Exercise 2: MA intuition

In MA(1), what drives the series: past values or past shocks?

## Solution 2

- Past shocks (errors).

## Exercise 3: White noise

What is white noise?

# Solution 3

- Uncorrelated errors with mean 0 and constant variance.

# Mini Demo (Python)

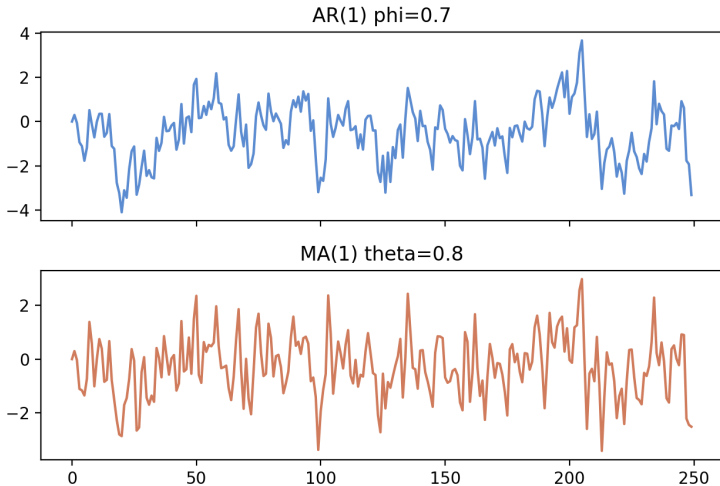
Run from the lecture folder:

```
python demo/demo.py
```

Outputs:

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

# Demo Output (Example)



# 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

How are AR and MA models different in what they remember?