

Statistics and Data Analysis

Unit 06 – Lecture 03 Notes

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Topic

Autoregressive (AR) and moving average (MA) models (intro).

Learning Outcomes

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

Detailed Notes

These notes are designed to be read alongside the slides. They expand each slide bullet into plain-language explanations, small worked examples, and common pitfalls. When a formula appears, emphasize (1) what each symbol means, (2) the assumptions needed to use it, and (3) how to interpret the final number in the problem context.

AR

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

MA

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

Exercises (with Solutions)

Exercise 1: AR intuition

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

Solution

- Next value tends to be high too.

Exercise 2: MA intuition

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

Solution

- Past shocks (errors).

Exercise 3: White noise

What is white noise?

Solution

- Uncorrelated errors with mean 0 and constant variance.

Exit Question

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

Demo (Python)

Run from the lecture folder:

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

Output files:

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

References

- Montgomery, D. C., & Runger, G. C. *Applied Statistics and Probability for Engineers*, Wiley.
- Devore, J. L. *Probability and Statistics for Engineering and the Sciences*, Cengage.
- McKinney, W. *Python for Data Analysis*, O'Reilly.