

Statistics and Data Analysis

Unit 06 – Lecture 02: Smoothing (Moving Average and Exponential Smoothing)

Tofik Ali

School of Computer Science, UPES Dehradun

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

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Learning Outcomes

- Explain why smoothing is used (noise reduction)

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- Describe moving average and its window effect

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- Explain why smoothing is used (noise reduction)
- Describe moving average and its window effect
- Describe exponential smoothing and alpha effect
- Discuss responsiveness vs smoothness trade-off

Moving Average: Key Points

- Average last k points

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- Larger k - i smoother but more lag

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- Average last k points
- Larger k - i smoother but more lag
- Good for trend visualization

Exponential Smoothing: Key Points

- Weighted average with decay

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- Alpha near 1 - \downarrow responsive

Exponential Smoothing: Key Points

- Weighted average with decay
- Alpha near 1 - \downarrow responsive
- Alpha near 0 - \downarrow smooth

Exponential Smoothing: Key Formula

$$s_t = \alpha x_t + (1 - \alpha)s_{t-1}$$

Exercise 1: Window effect

Increase window from 3 to 15: what happens?

Solution 1

- Smoother, more lag.

Exercise 2: Alpha

If $\alpha=0.9$, smoothing is strong or weak?

Solution 2

- Weak smoothing (very responsive).

Exercise 3: Too much smoothing

Why can too much smoothing harm forecasting?

Solution 3

- It can hide real changes and add lag.

Mini Demo (Python)

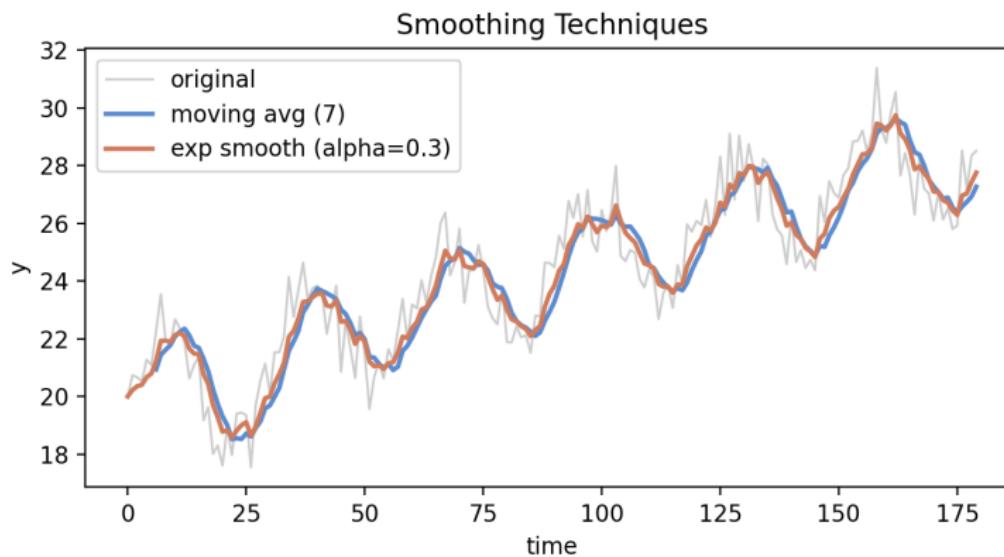
Run from the lecture folder:

```
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

What is one sign that your smoothing window is too large?