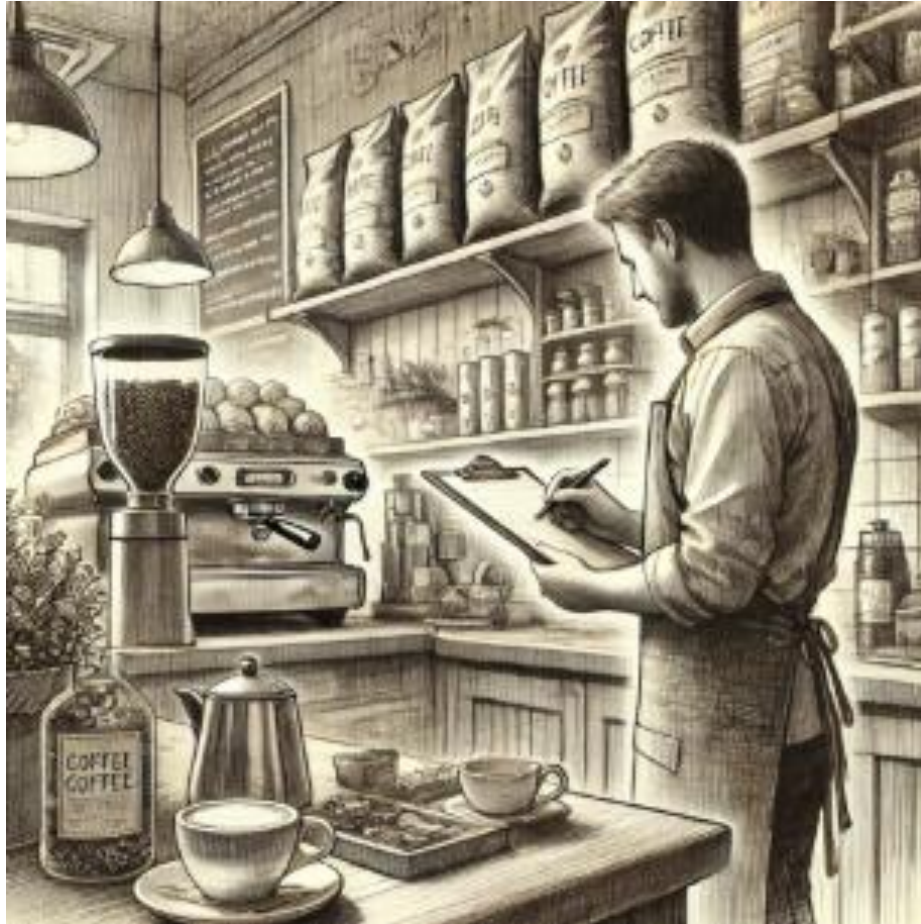# Exponential Weighted Moving Average (EWMA)

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Motivation:

Imagine you are managing coffee shop. Every day, you order coffee beans based on your past sales.
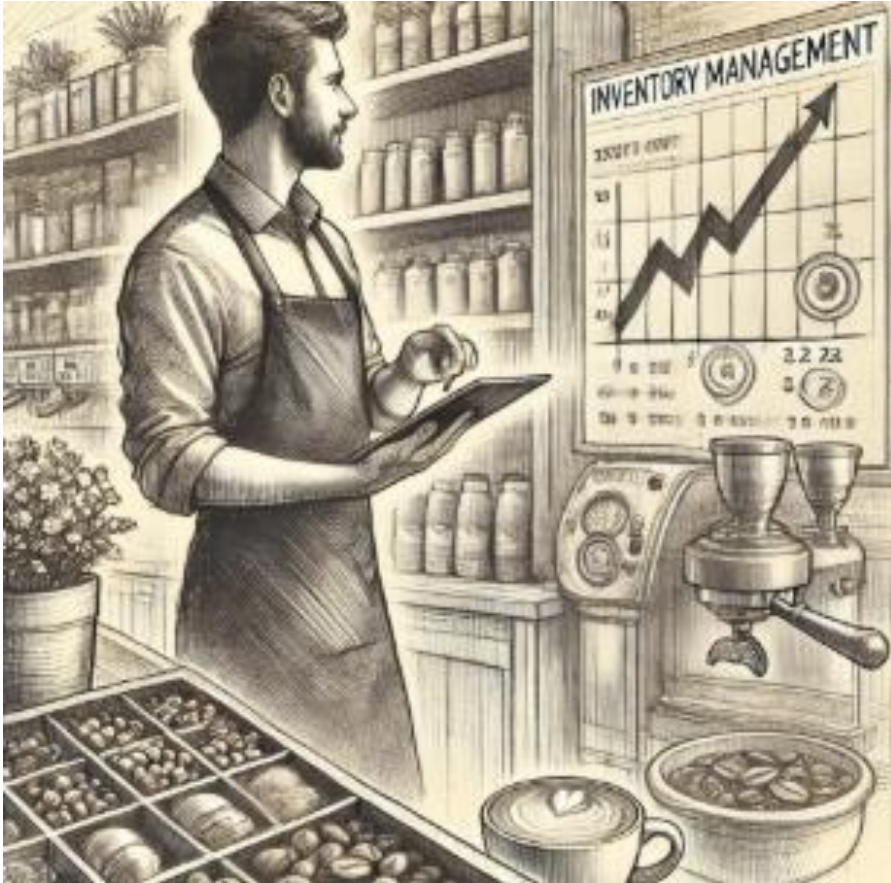
Motivation:

Recently, you noticed sudden changes: some day you run out early, other days you have left overs.

Motivation:

How can you adjust quickly to avoid disappointing customers and lost profits?

This is where EWMA helps!

By using EWMA, you prioritize recent sales information to quickly adapt your orders, ensuring you always have the right amount of coffee beans.

EWMA

- a statistical method used to analyze data trends over time.
- unlike SMA, it assigns importance ("weight") to recent observations, with older data gradually receiving less importance.

Why use EWMA?

-   recent data carries more relevance that older data
-   data contains noise or random fluctuations
-   rapid detection of changes is crucial

Key Components:

1. Smoothing Factor (**λ – lambda**)
    - determines the emphasis given to recent data
    - value ranges from 0 to 1
    - a higher **λ** indicates more emphasis on recent data

Key Components:

2. Previous EWMA value

    - the previous EWMA calculation influences current EWMA, for smooth transitions and continuity

Motivation on Choosing the Smoothing Factor (λ)

Higher λ (close to 1)
 - places significant importance on recent data
 - you want quick detection of recent changes

Lower λ (close to 0)
 - assigns greater weight to historical data
 - you want a more stable and less volatile trend analysis

Best Practices for Selecting λ

Note: There is no single perfect λ value, but this general guidelines help:

  a) Typical values range between 0.2 to 0.5 for balanced responsiveness
  b) Use historical data to experiment and choose a value that best fits your situation
  c) Regularly review and adjust λ, if circumstances or data behavior change

EWMA Formula

$$EWMA_t = \lambda \times (Current\ Value) + (1 - \lambda) \times (Previous\ EWMA)$$

λ: Smoothing factor
Current Value: Most recent data
Previous EMWA: Last Calculated EWMA value

Simple Example

Imagine tracking website traffic daily:

Monday:	100
Tuesday:	120
Wednesday:	90
Thursday:	130

Using λ = 0.3 (moderate responsiveness)

Monday's EWMA: 100 (initial value)
Tuesday: (0.3 * 120) + (0.7 * 100) = 106
Wednesday: (0.3 * 90) + (0.7 * 106) = 101.2
Thursday: (0.3 * 130) + (0.7 * 101.2) = 109.84

Using λ = 0.4 (moderate responsiveness)

Monday's EWMA: 100 (initial value)
Tuesday: (0.4 * 120) + (0.6 * 100) = 108
Wednesday: (0.4 * 90) + (0.6 * 108) = 100.8
Thursday: (0.4 * 130) + (0.6 * 100.8) = 112.48

[Code Demo]

Thank you very much for listening.