Given a running stream of numbers, compute Mean & variance at any given point.

Soln

Suppose the number are,

$$X_1, X_2, X_3, X_4 \ldots\ldots X_n$$

$$E(X) = M = \frac{1}{n} \sum_{i=1}^{n} X_i$$

$$\sigma = \sqrt{\frac{1}{n} \sum_{i=1}^{n} (X_i - \mu)^2} \quad , \text{Std dev} = \sigma^2$$

We can't use this formula, because if at any time when numbers increases or decreases the mean changes.

So,

$i \rightarrow$ Mnew

Time :- $O(N)$

So this a slower process. Computing mean time & again.

So, a better solution is :-

$$\sigma^2 = \frac{1}{n}\left[\sum_{i=1}^{n}(x_i - \mu)^2\right]$$

$$= \frac{1}{n}\left[\sum_{i=1}^{n} x_i^2 + \sum \mu^2 - 2\mu \sum_{i=1}^{n} x_i\right]$$

$$= \frac{1}{n}\left[\sum x_i^2 + n\mu^2 - 2\mu \sum_{i=1}^{n} x_i\right]$$

$$= \frac{\sum x_i^2}{n} + \mu^2 - 2\mu^2 \left[\because \frac{x_i}{n} = \mu\right]$$

$$\sigma = \sqrt{\underbrace{E(X^2)} - E(X)^2}$$

Mean when all number are squared

So, now it is easier.

$E(X)$, Mean $= \frac{\sum x}{N}$

$E(X^2) = \frac{\sum x^2}{N}$

{ For each new number add the number and get the result }