Updating Standard deviation

$$\sigma = oldStd = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}}$$

$$\text{So } \sigma^2 = \frac{\sum_{i=1}^{n}(x_i - oldMean)^2}{n-1}$$

$$= \frac{\sum_{i=1}^{n}\left(x_i^2 + (\bar{x})^2 - 2(x_i \cdot \bar{x})\right)}{n-1}$$

$$= \frac{\sum_{i=1}^{n} x_i^2 + n \times \bar{x}^2 - 2 \times \sum_{i=1}^{n} x_i \cdot \bar{x}}{n-1}$$

$$= \frac{\sum_{i=1}^{n} x_i^2 + n\bar{x}^2 - 2n\bar{x}\bar{x}}{n-1}$$

$$= \frac{\sum_{i=1}^{n} x_i^2 - n(\bar{x})^2}{n-1}$$

$$\text{So } \sum_{i=1}^{n} x_i^2 = (n-1)(OldStd)^2 + n(OldMean)^2$$

Now restart newStd, same formula as above

$$newStd^2 = \frac{\sum_{i=1}^{n+1} x_i^2 - (n+1)(newMean)^2}{n}$$

Now $\sum_{i=1}^{n+1} x_i^2 = \sum_{i=1}^{n} x_i^2 + (\text{newdata})^2$

$= (n-1)(\text{OldStd})^2 + n(\text{OldMean})^2 + (\text{newdata})^2$

so $(\text{newStd})^2 = \dfrac{(n-1)(\text{OldStd})^2 + n(\text{OldMean})^2 + (\text{newdata})^2 - (n+1)(\text{newMean})^2}{n}$

so, Final Formula.

$$\text{newStd} = \sqrt{\frac{(n-1)(\text{OldStd})^2 + n(\text{OldMean})^2 + (\text{newdata})^2 - (n+1)(\text{newMean})^2}{n}}$$