Normal Distribution Formulae:

Sample Mean =
n = number of observations

Sample Variance = $s^2 = \frac{\sum(x-\bar{x})^2}{n}$

Shortcut = $s^2 = \frac{\sum x^2 - \left(\frac{\sum x}{n}\right)^2}{n}$

Sample Standard Deviation = $s = \sqrt{s^2} = \sqrt{\frac{\sum(x-\bar{x})^2}{n}}$

Stock Return Formulae:

E(x) = expected return of stock x

Average Return = $\frac{E(x)+E(y)}{2}$

Average Return for Multiple Stocks = $\frac{E(x_1)+\cdots+E(x_n)}{n}$
n = number of stocks

Variance of 2 correlated Stocks –

$$var(x+y) = var(x) + var(y) + 2\,cov(x,y)$$

Standard Deviation = $\sqrt{var(x,y)}$

I.I.D. Formulae:

Standard Deviation: Recall variance and standard deviation formulae from earlier (normal distribution)

To find the standard deviation you must first find the variance

Variance: For any two random variables, that are uncorrelated: Cov(x,y) = 0

$$var(x+y) = var(x) + var(y)$$

Standard Deviation = $\sqrt{var(x) + var(y)}$ or $\sqrt{var(X+Y)}$

I.I.D. Average of Sums: Variance

2 Stock Portfolio:

$$var\left(\frac{x+y}{2}\right) = var\left(\frac{x}{2}\right) + var\left(\frac{y}{2}\right)$$

$$= \left(\frac{1}{2}\right)^2 [var(x) + var(y)] = \frac{1}{4}[var(x) + var(y)]$$

Multi Stock Portfolio:

$$\left(\frac{1}{n}\right)^2 [var(x_1) + var(x_2) + \cdots + var(x_n)]$$

I.I.D. Average of Sums: Standard Deviation

σ_p = Standard Deviation of portfolio:

$$\sigma_p = \sqrt{var\left(\frac{x_1 + x_2 + \cdots + x_n}{n}\right)}$$

$$= \sqrt{\left(\frac{1}{n}\right)^2 var(x_1 + x_2 + \cdots + x_n)}$$

$$= \sigma_p = \frac{1}{n}\sqrt{var(x_1) + var(x_2) + \cdots + var(x_n)}$$

Note: if $var(x_1) = var(x_2) = var(x_n) = var(x)$

$$\sigma_p = \frac{1}{n}\sqrt{n \cdot var(x)}$$

$$\sigma_p = \frac{\sqrt{n}}{n} \cdot \sqrt{var(x)}$$

$$\sigma_p = \frac{\sigma(x)}{\sqrt{n}}$$

Note: $n = \left(\sqrt{n}\right)^2$

$\sigma(x) = \sqrt{var(x)}$