TOOLS: The table below summarizes variances of combinations of random variables.

VARIANCE (OR SQUARE OF STANDARD DEVIATION), 1 RANDOM VAR

$$\sigma_X^2 = E\left((X-\mu_X)^2\right) = \int_{-\infty}^{\infty}(x-\mu_X)^2 f_X(x)dx = E(X^2)-(\mu_X)^2$$

$$\sigma_{aX+b}^2 = a^2\sigma_X^2 \qquad \sigma_{aX+b} = a\sigma_X$$

VARIANCE (OR SQUARE OF STANDARD DEVIATION), ANY 2 RAND VARS

$\sigma_{aX+bY}^2 = a^2\sigma_X^2 + b^2\sigma_Y^2 + 2ab\sigma_{XY}$ (see covariance below)

VARIANCE (OR SQUARE OF STAND DEV), 2 INDEPENDENT RAND VARS

$$\sigma_{aX+bY}^2 = a^2\sigma_X^2 + b^2\sigma_Y^2$$

COVARIANCE, ANY 2 RANDOM VARIABLES

$$\sigma_{XY} = E(XY)-\mu_X\mu_Y = E((X-\mu_X)(Y-\mu_Y)) = \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} xyf(x,y)dydx - \mu_X\mu_Y$$

$$\sigma_{aXbY} = ab\sigma_{XY}$$

COVARIANCE, 2 INDEPENDENT RANDOM VARIABLES

$$\sigma_{XY} = 0$$

CORRELATION, ANY 2 RANDOM VARIABLES

$$\rho_{XY} = \frac{\sigma_{XY}}{\sigma_X\sigma_Y} = \frac{\sigma_{XY}}{\sqrt{\sigma_X^2\sigma_Y^2}}$$

$$\rho_{aXbY} = \rho_{XY}$$

CORRELATION, 2 INDEPENDENT RANDOM VARIABLES

$$\rho_{XY} = 0$$