TOOLS: The table below summarizes the values for means of combinations of random variables.

MEAN (OR EXPECTED VALUE), 1 RANDOM VARIABLE

$$E(X) \equiv \mu_X = \int_{-\infty}^{\infty} x f_X(x) dx$$

$$E(aX+b) = aE(X)+b \qquad \mu_{aX+b} = a\mu_X + b$$

$$E(g(X)) = \int_{-\infty}^{\infty} g(x) f_X(x) dx = \int_{-\infty}^{\infty} g(x) \left[\int_{-\infty}^{\infty} f(x,y) dy \right] dx$$

$$\mu_{g(X)} = \int_{-\infty}^{\infty} g(x) f_X(x) dx = \int_{-\infty}^{\infty} g(x) \left[\int_{-\infty}^{\infty} f(x,y) dy \right] dx$$

NOTE: Typically, $E(g(X)) \neq g(E(X))$ and $\mu_{g(X)} \neq g(\mu_X)$ unless $g(\ )$ is a linear function.

MEAN (OR EXPECTED VALUE), ANY 2 RANDOM VARIABLES

$$E(aX+bY) = aE(X)+bE(Y) \qquad \mu_{aX+bY} = a\mu_X + b\mu_Y$$

$$E(g(X)+h(Y)) = E(g(X)) + E(h(Y)) = \int_{-\infty}^{\infty} g(x) f_X(x) dx + \int_{-\infty}^{\infty} h(y) f_Y(y) dy$$

$$\mu_{g(X)+h(Y)} = \mu_{g(X)} + \mu_{h(Y)}$$

$$E(XY) \equiv \mu_{XY} = \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} xy f(x,y) dy dx$$

$$E(aXbY) \equiv ab\,\mu_{XY}$$

MEAN (OR EXPECTED VALUE), 2 INDEPENDENT RANDOM VARIABLES

$$E(XY) = E(X)E(Y)$$

$$\mu_{XY} = \mu_X \mu_Y$$