Simple Identities

St $E[X - E[X]] = 0$

$$E[y] = \int_{-\infty}^{\infty} y \, f_y(y) \, dy$$

$$E[X - E[X]] = \int_{-\infty}^{\infty} \left(x P_x(x) - \int_{-\infty}^{\infty} x P_x(x) \, dx \right) dx$$

$$= \int_{-\infty}^{\infty} x P_x(x) - \int_{-\infty}^{\infty} x P_x(x) \, dx \, dx$$

$$= \int_{-\infty}^{\infty} x P_x(x) \, dx - \int_{-\infty}^{\infty} x P_x(x) \, dx$$

$$= 0$$