Suppose $X_1, \ldots, X_{2500}$ are independent Bernoulli random variables, each with $E(X_j) = \frac{1}{3}$ and $Var(X_j) = (\frac{1}{3})(\frac{2}{3})$.

Find $P(830 \le X_1 + \ldots + X_{2500} \le 840)$

$$= \sum_{y=830}^{840} \binom{2500}{y} (1/3)^y (2/3)^{2500-y}$$ still not pleasant to calculate.

$$P(829.1 \le \underbrace{X_1 + \ldots + X_{2500}}_{\text{these are integer valued}} \le 840.7)$$

$$\begin{array}{cc|cccccc|cc} 828 & 829 & 830 & 831 & \ldots & 838 & 839 & 840 & 841 & 842 \\ \text{NO} & \text{NO} & & & & & & & \text{NO} & \text{NO} \end{array}$$

829.5 continuity correction. 840.5

Again I am approximating the behavior of a discrete random variable by the behavior of a continuous random variable.

$$P(830 \le Y \le 840) = P(829.5 \le Y \le 840.5)$$

$$= P\left(\frac{829.5 - 2500(1/3)}{\sqrt{2500(\frac{1}{3})(\frac{2}{3})}} \le \frac{Y - 2500(1/3)}{\sqrt{2500(\frac{1}{3})(2/3)}} \le \frac{840.5 - 2500(1/3)}{\sqrt{2500(1/3)(2/3)}}\right)$$

$$\approx P(-0.16 \le Z \le 0.30)$$

$$= P(Z \le 0.30) - P(Z \le -0.16)$$

$$= 0.6179 - (1 - 0.5636) = 0.1815$$

actual value by the way is 0.1839588....

the approximation is pretty good!