(2) **Coin throws**
An unfair coin is thrown 600 times. The probability of geting a tail in each throw is $\frac{1}{4}$.

(a) Use a Binomial distribution to compute the probability that the number of heads obtained does not differ more than 10 from 450.

(b) Use a Normal approximation without a continuity correction to calculate the probability in (a). How does the result change if the approimation is provided with a continuity correction?

a) Y ... number of tails after 600 tosses, $Y \sim \text{Bin}(n,p)$, $n = 600$, $p = \frac{1}{4}$

$$\mathbb{P}(|(600-Y)-450| \leq 10) = \mathbb{P}(|150-Y| \leq 10) = \mathbb{P}(140 \leq Y \leq 160) \overset{R}{\approx} 0{,}68$$

b) $Y \approx Z \sim N(np, np(1-p))$

symmetry of normal

$$\mathbb{P}(140 \leq Z \leq 160) = 1 - \mathbb{P}(Z < 140) - \mathbb{P}(Z > 160) = 1 - \mathbb{P}(Z < 140) - \mathbb{P}(Z < 140)$$

$$= 1 - 2\mathbb{P}(Z < 140) \overset{R}{\approx} 0{,}65$$

$$np = \frac{600}{4} = 150; \quad np(1-p) = \frac{600}{4}\,\frac{3}{4} = \frac{3 \cdot 150}{4} = \frac{450}{4} = \frac{225}{2}$$

with continuity correction:

$$\mathbb{P}(140 \leq Y \leq 160) \approx \mathbb{P}(140 - \tfrac{1}{2} < Z < 160 + \tfrac{1}{2}) = 1 - 2\mathbb{P}(Z < 140 - \tfrac{1}{2}) \overset{R}{\approx} 0{,}68$$