

## Solution for exercise 2.2.6 in Pitman

We introduce the events  $O_i$  to describe that  $i$  voters in the survey oppose the measure. From section 2.1 box at bottom of page 81 we deduce that  $X$  is binomially distributed.

**Question a)** The probability in question is (page 81)

$$P(O_{90}) = \binom{200}{90} 0.45^{90} 0.55^{110}$$

We evaluate this probability by approximation page 99.

$$\begin{aligned} P(O_{90}) &\simeq \Phi\left(\frac{90 + \frac{1}{2} - 0.45 \cdot 200}{\sqrt{200 \cdot 0.45 \cdot (1 - 0.45)}}\right) - \Phi\left(\frac{90 - \frac{1}{2} - 0.45 \cdot 200}{\sqrt{200 \cdot 0.45 \cdot (1 - 0.45)}}\right) \\ &= \Phi(0.07) - \Phi(-0.07) = 2 \cdot \Phi(0.07) - 1 = 0.056 \end{aligned}$$

**Question b)** The probability in question is

$$\begin{aligned} P(\text{more than 100 voters oppose the measure}) &= P(\cup_{i=101}^{200} O_i) \simeq \\ &\Phi\left(\frac{200 + \frac{1}{2} - 0.45 \cdot 200}{\sqrt{200 \cdot 0.45 \cdot (1 - 0.45)}}\right) - \Phi\left(\frac{101 - \frac{1}{2} - 0.45 \cdot 200}{\sqrt{200 \cdot 0.45 \cdot (1 - 0.45)}}\right) = 1 - \Phi(1.49) = 0.0681 \end{aligned}$$