Solution for exercise 2.5.4 in Pitman

We have sampling without replacement. The probability in question can be derived from the result on page 125. First we use this result to state the probability that we get exactly i men in the sample

$$P(i) = P(i \text{ men}) = \frac{\binom{40,000}{i}\binom{60,000}{100-i}}{\binom{100,000}{100}}$$

then the probability in question can be found as

$$P(\text{at least 45 men in sample}) = \sum_{i=45}^{100} \frac{\binom{40,000}{i}\binom{60,000}{100-i}}{\binom{100,000}{100}}.$$

We approximate the probabilities $P(i)$ using the binomial distribution

$$P(i) \tilde{=} \binom{100}{i} 0.4^i 0.6^{100-i}$$

$$P(\text{at least 45 men in sample}) = \sum_{i=45}^{100} \binom{100}{i} 0.4^i 0.6^{100-i} = 1 - P(\text{at most 44 men in sample}).$$

The latter probability can be evaluated approximately with the normal approximation.

$$P(\text{at most 44 men in sample}) \tilde{=} \Phi\left(\frac{44+\frac{1}{2}-40}{\sqrt{100 \cdot 0.4 \cdot 0.6}}\right) = \Phi(0.92) = 0.8212.$$

Finally

$$P(\text{at least 45 men in sample}) \tilde{=} 0.1788$$

(the skewness correction is (0.0003) if you would like to apply that too).