1. A company wants to understand what proportion ($p$) of customer's opt to give their change to a local charity. The plan is to take a random sample of the customers and record whether or not the customer gave their change to the charity. Define the random variable $X_i$ for the response of the $i$th customer where a 0 represents that they did not give and a 1 represents that they did.

   (a) What is $E[X_i]$?

   (b) What is $E[\overline{X}]$?

   (c) Is $E[\overline{X}]$ unbiased for the proportion $p$?

   (d) What is the variance of $X_i$?

   (e) What is the standard deviation of $X_i$?

   (f) What is the standard error of $\overline{X}$?

2. Continue the previous example and suppose $p = 0.5$.

   (a) What sample size is needed so that with (approximately) 68% probability we are within 0.1 of the true population proportion?

   (b) What sample size is needed so that with (approximately) 95% probability we are within 0.1 of the true population proportion?

   (c) What sample size is needed so that with (approximately) 99.7% probability we are within 0.1 of the true population proportion?

   (d) How will these sample sizes change if $p$ is closer to 0 or 1?