## **15.3 Exercises**

1. Suppose you poll a population in which a proportion pp of voters are Democrats and 1−p1−p are Republicans. Your sample size is N=25N=25. Consider the random variable SS which is the **total** number of Democrats in your sample. What is the expected value of this random variable? Hint: it’s a function of pp.

2. What is the standard error of SS ? Hint: it’s a function of pp.

3. Consider the random variable S/NS/N. This is equivalent to the sample average, which we have been denoting as ¯XX¯. What is the expected value of the ¯XX¯? Hint: it’s a function of pp.

4. What is the standard error of ¯XX¯? Hint: it’s a function of pp.

5. Write a line of code that gives you the standard error se for the problem above for several values of pp, specifically for p <- seq(0, 1, length = 100). Make a plot of se versus p.

6. Copy the code above and put it inside a for-loop to make the plot for N=25N=25, N=100N=100, and N=1000N=1000.

7. If we are interested in the difference in proportions, p−(1−p)p−(1−p), our estimate is d=¯X−(1−¯X)d=X¯−(1−X¯). Use the rules we learned about sums of random variables and scaled random variables to derive the expected value of dd.

8. What is the standard error of dd?

9. If the actual p=.45p=.45, it means the Republicans are winning by a relatively large margin since d=−.1d=−.1, which is a 10% margin of victory. In this case, what is the standard error of 2^X−12X^−1 if we take a sample of N=25N=25?

10. Given the answer to 9, which of the following best describes your strategy of using a sample size of N=25N=25?

1. The expected value of our estimate 2¯X−12X¯−1 is dd, so our prediction will be right on.
2. Our standard error is larger than the difference, so the chances of 2¯X−12X¯−1 being positive and throwing us off were not that small. We should pick a larger sample size.
3. The difference is 10% and the standard error is about 0.2, therefore much smaller than the difference.
4. Because we don’t know pp, we have no way of knowing that making NN larger would actually improve our standard error.