The Normal Approximation for Probability Histograms

1. Five coins are to be tossed and the number of heads counted. The number of heads is like the sum of five draws (with replacement) from a box with two tickets 1 (for heads) and 0 (for tails).

> **source**("http://www.adjoint−functors.net/su/web/314/R/BoxSimulations.R");

a) Generate data like that in Table 1 on page 309 of your text.

> **table**(boxSimulation(**c**(0, 1), 5, 100))

Are the numbers generated by R the same as those shown in the table? Why or why not? Enter the command again. Does R generate the same numbers? Why or why not?

b) Make a histogram of the data from 100 repetitions of tossing five coins.

> boxHistogram(**c**(0,1), 5, 100, breaks=−0.5+(0:6))

c) Increase the number of repetitions from 100 to 1000.

> boxHistogram(**c**(0,1), 5, 1000, breaks=−0.5+(0:6))

How many repetitions does it take before the histograms no longer appear to change?

d) Increase the number of coins from 5 to 10.

> boxHistogram(**c**(0,1), 10, 1000, breaks=−0.5+(0:11))

As you increase the number of coins, keeping the number of repetitions fixed, does the histogram tend to look more like a normal curve or less?

2. Two dice are to be rolled and the sum of the number of spots counted.

> **source**("http://www.adjoint−functors.net/su/web/314/R/diceSimulations.R");

a) Generate data like that in Table 2 on page 310 of your text.

> diceSimulation(100)

Are the numbers generated by R the same as those shown in the table? Why or why not? Enter the command again. Does R generate the same numbers? Why or why not?

b) Plot a histogram of the data from 100 repetitions of rolling two dice.

> diceHistogram(100)

Does your plot differ from the one at the top of Figure 1 on page 311 of your text? Increase the number of repetitions to try to reproduce the other plots in Figure 1. For example:

> diceHistogram(1000)

How many repetitions does it take before the histograms no longer appear to change?

c) Change the color of the histogram bars then try to discover some other colors that R knows.

> diceHistogram(1000, color="green")

d) Change the number of dice.

> diceHistogram(1000, dice=3)

As you increase the number of dice, keeping the number of repetitions fixed, does the histogram tend to look more like a normal curve or less?

3. Two dice are to be rolled and the product of the number of spots counted.

a) Generate data for 100 repetitions of the experiment.

> diceSimulation(100, diceSum=FALSE)

Enter the command again. Does R generate the same numbers? Why or why not?

b) Plot a histogram of the data from 100 repetitions of rolling two dice.

> diceHistogram(100, diceSum=FALSE)

Does your plot differ from the one at the top of Figure 2 on page 313 of your text? Why are there gaps in the histogram?

Increase the number of repetitions to try to reproduce the other plots in Figure 2. For example:

> diceHistogram(1000, diceSum=FALSE)

How many repetitions does it take before the histograms no longer appear to change? Do the histograms look like a normal curve? Does your answer contradict The Central Limit Theorem (page 325)?

4. Consider sums of draws from the box describe in Figure 9 on page 322 of your text.

a) Plot a histogram of data from 100 repetitions of sums of 25 draws.

boxHistogram(**c**(1,2,9), 25, 100, ymax=0.1, breaks=160)

Does the histogram look like a normal curve?

b) Find formulas for the expected value, maximum sum, minimum sum and standard error for sums of n draws.

c) Increase the number of repetitions to get a plot that looks like the first one in Figure 9. You may need to decrease ymax and increase breaks.

d) Repeat c) for sums of 50 and 100 draws as shown in Figure 9.

5. Do exercise 5 from page 314 of your text. use boxHistogram to help and to check your answers.

6. Do exercise 5 from page 324 of your text. use boxHistogram to help and to check your answers.

7. Do exercise 6 from page 324 of your text. use boxHistogram to help and to check your answers.