Chapter 18: The Normal Approximation for Probability Histograms

This chapter is full of tricky theory at a higher level than the rest of the course; but our main interest is implementing the normal approximation to the binomial in 18.4.

Section 18.1: Read it lightly. It gives some historical background.

Section 18.2: The boxes on pages 310 and 312 are essential.

This section attempts to explain a somewhat difficult but useful concept. The distinction between the number of repetitions of the experiment and the number of trials that make up the experiment is very subtle.

Convergence of the data histograms to the probability histogram happens when the experiment is repeated a large number of times. We may think of the probability histogram as being the same as a data histogram in the case when the number of repetitions is infinitely large.

An example is in order to make this clear. Consider tossing three fair coins. The probability histogram for the number of heads has four blocks with areas 12.5%, 37.5%, 37.5%, and 12.5% for the results 0, 1, 2, 3 heads. If the three coins are tossed 10 times, the data histogram will not be very close to the probability histogram; but if they are tossed 1,000 times (number of repetitions is large), the data histogram will look very much like the probability histogram. The number of coins is still three, so the probability histogram will not change.

Suggested problems for study: A: pages 312 and 314: 1, 2; and (less important) pages 314 and 315: 3, 4, 6.

Section 18.3: Here, as the number of trials that make up the experiment is increased, the probability histogram will approach the normal curve.

Look again at the three coins. Their probability histogram does not look like the normal curve because it is a binomial case with the number of trials a small number (here three). But, if we increase the number of trails (coins) to one hundred, we get a data histogram (pictured on the bottom of page 315) that looks like the normal curve. The number of trials was increased from three to one hundred, changing the probability histogram to one that is more like the normal curve.

How close the data histograms will be to the probability histogram still depends on the number of repetitions, as in section 18.3. This is a subtle distinction.

Section 18.4: Any binomial probability where the number of trials is large may be approximated by the normal curve, because the process can always be modelled by a 0-1 box. Since it is a count, the enpoints should be adjusted up or down by 1/2.

The procedure in Example 1 of section 18.4 is the raison d'être of this chapter.

Suggested problems for study: B: pages 318 and 319: 1–3, 5; and (less important) problem 4 on page 319.

Section 18.5: Just read lightly.

Suggested problems for study: C: pages 324 and 325: 1, 2, 7, 8; and (less important) 3 and 4 on page 324

Section 18.6: The box on page 325 is important.

Chapter Summary: pages 329 and 330: None of the points are important.

Review Exercises

Homework (pages 327 and 328): 2, 4, 5, 6, 8

Comments on HW:

Problem 4 requires some careful thought. First, are two separate questions being asked: 12 heads and 13 tails? Or is it all one outcome? Do not make a mistake here. Then there are two ways to complete the problem. Either use a calculator and the binomial formula. Or use the normal approximation. It is essential that the continuity correction be used with such a small number of tosses.

This problem will be emphasized on future tests.

Problems 2 and 8 are of extreme importance. They will be essential parts of future tests.