Arrows

1. An Olympic archer is able to hit the bull's-eye 80% of the time. Assume exact shot is independent of the other. She shoots 10 arrows.
   1. Find the mean and standard deviation of the number of bull's-eyes she may get.

Sqrt(10 \* .8 \* .2) = 1.265

* 1. What is the probability that she never misses?

(.8)^2 \* (.2)^0 = .107

* 1. What is the probability that there are no more than eight bull's-eyes?
  2. What is the probability that there are exactly eight bull's-eyes?
  3. What's the probability that she hits the bull's-eye more often than she misses?

1. The archer will be shooting 200 arrows in a large competition.
   1. What are the mean and standard deviation of the number of bull's-eyes she might get?

Mean = 200 \* .8 => 160

SD = sqrt(200 \* 0.8 \* 0.2) => 5.66

* 1. Is a Normal Model an appropriate approximation here? Explain.
  2. Use the 68-95-99.7 Rule to describe the distribution of the number of bull's-eyes she may get.

68 = 160-5.66 -> 160+5.66 >> 154.34 -> 165.66

95 = 160-5.66\*2 -> 160+5.66\*2 >> 148.68 -> 171.32

99.7 = 160-5.66\*3 -> 160+5.66\*3 >> 143.02 -> 176.98

* 1. Would you be surprised if she made only 140 bull's-eyes? Explain.

Yes, I would be very surprised. That’s more than 3 SDs away from the mean, so it should happen less than .15% of the time.

1. Our archer purchases a new bow, hoping that it will improve her success rate to more than 80% bull's-eyes. She is delighted when she first tests her new bow and hits six consecutive bull's-eyes. Do you think this is compelling evidence that the new bow is better? In other words, is a streak like this unusual for her? Explain.

No, a steak like this shouldn’t surprise her. 0.8^6 = .2621 => 26.21%. So 26% of the time she’ll hit 6 in a row.

1. The archer continues shooting arrows, ending up with 45 bull's-eyes in 50 shots. Now are you convinced that the new bow is better? Explain.

Now we can be convinced that the new bow is better. That’s 90% bulls-eyes where as before she was shooting 80%.

M&Ms

1. The candy company claims that 10% of the M&Ms it produces are green. Suppose that the candies are packaged at random in small bags containing about 50 M&Ms. A class of elementary school students learning about percents opens several bags, counts the various colours of candies, and calculates the proportion that are green.
   1. If we plot a histogram showing the proportions of green candies in the various bags, what shape would you expect it to have?

We would expect it to be unimodal, and relatively symmetric.

* 1. Can this histogram be approximated by a Normal model? Explain.

No we can’t use the normal model to approximate this histogram. The expected number of green M&Ms is 50(.1) => 5, which is less than 10, so the success/fail condition isn’t met.

* 1. Where should the centre of the histogram be?

.1, around the green M&Ms

* 1. What should the standard deviation of the proportion be?

.042

1. Suppose the class buys bigger bags of candy, with 200 M&Ms each. Again the students calculate the proportion of green candies they find.
   1. Explain why it's appropriate to use a Normal model to describe the distribution of the proportion M&Ms they might expect.
   2. Use the 68-95-99.7 Rule to describe how this proportion might vary from bag to bag.
   3. How would this model change if the bags contained even more candies?
2. In a really large bag of M&Ms, the students found 500 candies, and 12% of them were green. Is this an unusually large proportion of green M&Ms?