Part 1 – Investigating a Binomial Distribution

A ***binomial distribution*** is a random distribution with the following properties:

- There are *n* repeated trials that are identical and independent.
- Each trial has two possible outcomes, in general known as a success or failure.
- *P*(success) = *p* and *P*(failure) = 1 – *p*

The following is an example of a binomial distribution.

The survival rate for Emperor penguin eggs is 19%. If there are 100 penguins in a waddle that lay an egg this year, what is the probability that 25 eggs will hatch?

Let's first investigate this problem using a simulation with 200 repeated trials.

Step 1: Open a *Lists & Spreadsheet* page and name the first column.

Step 2: Type **=randbin(100, 0.19, 200)** in the gray formula cell. Each cell represents the number of penguin eggs that live out of 100 born.

Step 3: Graph the results by inserting a Quick Graph (**MENU > Data > Quick Graph**).

- What is the experimental probability that 25 penguins will survive? How do your results compare with your classmates?

Now, let's find the theoretical probability. In general, the probability of *r* successes in *n* trials where *p* is the *P*(success) is:

$$\binom{n}{r} p^r (1-p)^{n-r}$$

Step 4: Use Scratchpad to find this probability. _____

Step 5: This can also be calculated using the **binomPdf** command. Choose **MENU > Probability > Distributions > Binomal Pdf**. A menu will appear asking for *n* (the number of trials), *p* (the probability of success) and *x* (the number of successes).

- How does your experimental probability compare to the theoretical probability?

What is the probability that at least 25 eggs hatch?

- How could this be calculated? Discuss your idea with a classmate.

Step 6: Use the **binomCdf** command to calculate the probability that at least 25 eggs hatch. From a *Calculator* page, choose **MENU > Probability > Distributions > Binomial Cdf**. A menu will pop up and ask for *n*, *p*, lower bound, and upper bound.

- Insert a *Calculator* page to find this probability. _____

What is the mean number of eggs that would be expected to hatch?

This can be calculated by finding the expected value of the binomial distribution. $\mu = np$.

- Use *Scratchpad* to find the expected value. _____

Homework

1. Of all the turkeys sold in the US, 1 out of 6 is eaten on Thanksgiving. A certain packing plant processes 2,000 turkeys in November.
   a. What is the probability that 25% of them will be eaten on Thanksgiving?
   b. What is the probability that less than 300 of the turkeys grown will be eaten on Thanksgiving?
   c. What is the expected number of turkeys to be eaten on Thanksgiving?

2. A professional basketball player is an 81% free throw shooter. In a game against Milwaukee, he made 12 free throw attempts.
   a. Is it possible that he missed all 12 shots? Explain why or why not.
   b. What is the probability that he made 9 free throws?
   c. What is the probability that he made at least 9 free throws?

3. Suppose a recent study showed that 35% of women in the United States were overweight. A large company has 400 women employees. Assume that they are a random selection of the US population.
   a. What is the probability that 140 of the women employed are overweight?
   b. What is the probability that at least 140 of the women are overweight?
   c. What is the probability that less than 20% of the women are overweight?