

Makin' It Through The Winter

ID: 11937

Time required
20 minutes

Activity Overview

In this teacher-led activity, students will simulate a binomial distribution. They will then calculate probabilities for a variety of situations involving binomial probability distributions.

Topic: Random Distributions

- *Binomial distributions*
- *Probabilities*

Teacher Preparation and Notes

- *This can be used as a stand alone lesson on binomial distributions. Homework problems are included. The student worksheet is needed if students are to work individually. It can be omitted if the lesson is teacher directed.*
- *Before beginning the activity, students should know combinations and basic probability rules.*
- *The student TI-Nspire document has the homework problems included. This allows the activity to be paper-free if it is teacher directed.*
- ***To download the student and solution TI-Nspire documents (.tns files) and student worksheet, go to education.ti.com/exchange and enter "11937" in the keyword search box.***

Associated Materials

- *ThroughWinter_Student.doc*
- *ThroughWinter.tns*
- *ThroughWinter_Soln.tns*

Suggested Related Activities

To download any activity listed, go to education.ti.com/exchange and enter the number in the keyword search box.

- *Binomial Experiments (TI-Nspire technology) — 9999*
- *Probability Distributions (TI-Nspire technology) — 8972*
- *An Approximation to the Binomial Distribution (TI-Nspire technology) — 9296*

Part 1 – Investigating a binomial distribution

Introduce random distributions and discuss the properties that make a distribution binomial. Have students generate examples of problems that would be a binomial distribution.

Page 1.2 describes a binomial distribution of penguin birth rates. Students are to explore a problem experimentally using a simulation.

On a *Lists & Spreadsheet* page, students are to give the first column a name that describes what each cell represents, such as **births** or **num_births**.

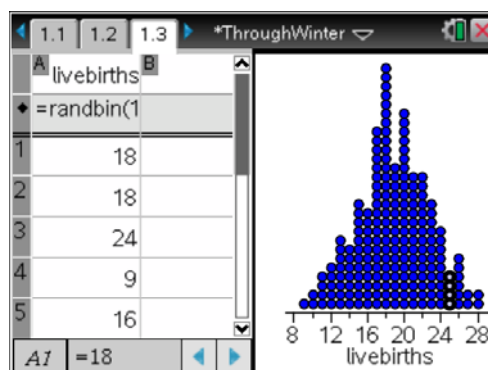
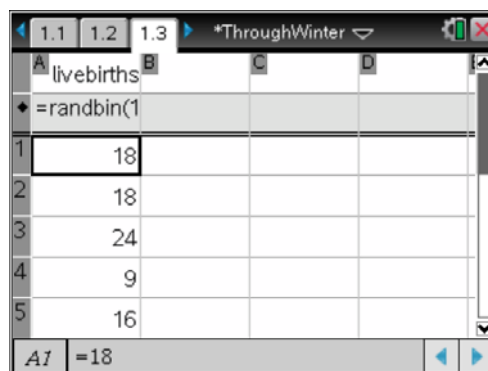
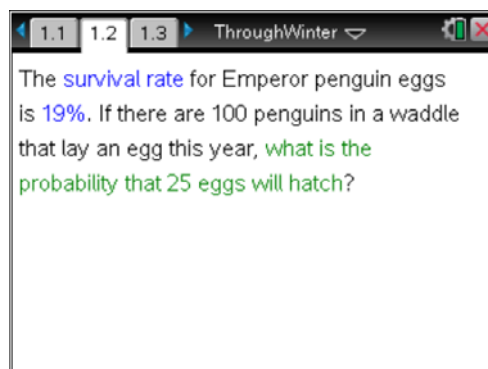
Students will be using the **Random Binomial** command which generates a random real number from a specified Binomial distribution.

$$\text{randBin}(n, p, (\text{optional \# of repetitions}))$$

In the formula cell, students will enter **=randBin(100, 0.19, 200)**. Each cell represents the number of penguins that hatch out of 100 eggs.

Then they are to graph the results as a dot plot using the **Quick Graph** command from the Data menu.

To determine the number of trials that resulted in 25 births, students will need to count the number of dots. They can click on a dot to make sure they are counting the right stack.



Discussion Questions:

- What do the numbers in each cell of the spreadsheet represent?
- What is the experimental probability for the class?
- What happens to the experimental probability as more trials occur?
- Is it possible to get no trials that had 25 penguins live? Why?
- What if the birth rate changes? How will it affect the probability?

Students will then calculate the theoretical probability of 25 hatched eggs. This can be done two ways. Using the formula for cumulative probability or using the calculator command, **Binomial Pdf**.

$$\text{binomPdf}(n, p, x)$$

For students to use the formula they will need to use the **nCr** command. To enter the Binomial Pdf command, they can select **MENU > Probability > Distributions > Binomial Pdf**. A menu appears asking for the number of trials, the probability of success, and the x-value (the number of successes).

Discussion Questions:

- Discuss why the first formula works.
- How would you calculate the probability that at least 25 penguins survive?

Now students are asked to determine the probability that at least 25 eggs hatch. Explain to students that this cumulative probability could be calculated by adding up individual probabilities ($P(25) + P(26) + P(27)$ etc). However, it can also be done using the **Binomial Cdf** command.

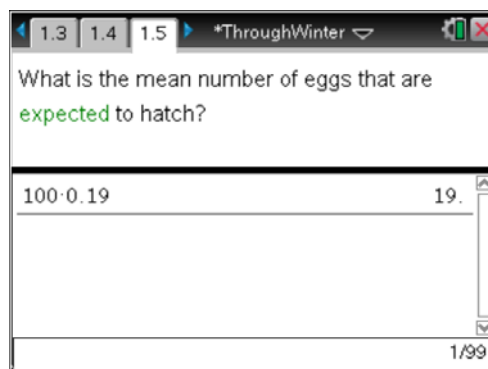
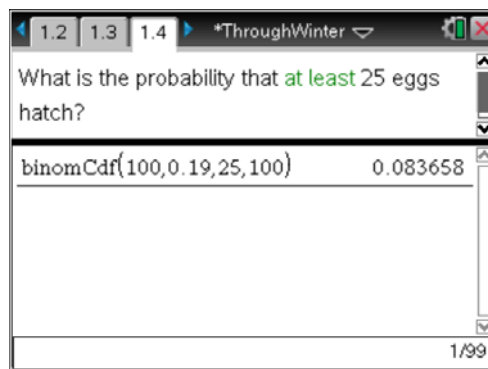
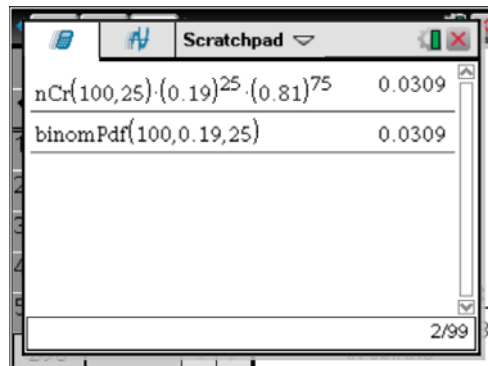
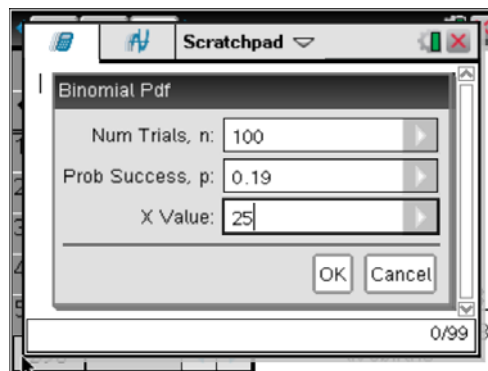
$$\text{binomCdf}(n, p, \text{low bound}, \text{upper bound})$$

On a *Calculator* page, students are to choose **MENU > Probability > Distributions > Binomial Cdf**.) When the menu appears, they are to enter the values for n , p , lower bound, and upper bound.

Discussion Questions:

- What is the probability that more than 25 penguins survive?
- How does this question differ from the one above?

Also discuss with students the expected value (also known as the mean) of a binomial distribution. It can be found using the formula, $\mu = np$. This should also be one of the tallest stacks of dots on the graph.



Homework

The student TI-Nspire document (.tns file) and the worksheet contain homework questions reinforcing the material from the activity. The tns. file has the questions so that the students may check their solutions.

Homework Solutions:

1. a. 0
b. 0.02
c. 333
2. a. True
b. 0.23
c. 0.82
3. a. 0.04
b. 0.52
c. 0

