Makin' It Through The Winter
ID: 11936

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.*
- *Before beginning the activity, students should know combinations and basic probability rules.*
- ***To download the student worksheet, go to education.ti.com/exchange and enter "11936" in the keyword search box.***

Associated Materials
- *MakinItThroughWinter_Student.doc*

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*
- *An Approximation to the Binomial Distribution (TI-Nspire technology) — 9296*
- *Binomial Distribution (TI-84 Plus family) — 1952*
- *Binomial Probability in Baseball (TI-84 Plus family) — 11200*

Problem 1 – Simulation

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

Students will explore a problem experimentally using the following simulation.

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?

Students will use a list to simulate the number of births. They will be using the **Random Binomial** command which generates a random real number from a specified Binomial distribution.

        randBin(*n, p*, (optional # of simulations))

Students should highlight **L1** and press MATH, arrow to the PRB menu and select **randBin(**. Then enter **100,0.19, 50)**. **This will take about a minute for the calculator to process.**

Each entry in the list represents the number of penguins that hatch out of 100 eggs.

To determine the number of trials that resulted in 25 births, students will sort the list on the Home screen and then return to the List Editor.

To enter L1 on the Home screen, press 2nd [L1] or press 2nd [LIST] and select L1.

Discussion Questions:

- What do the numbers in each entry in the list 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?

Problem 2 – Theoretical Probability

Students are to calculate the theoretical probability of 25 hatched eggs. This can be done two ways, either by using the formula for cumulative probability or using the **Binomial Probability Distribution** function command, **binompdf**.

For students to use the formula for cumulative probability they will need to use the **nCr** command. Remind them to enter the number of trials before choosing the **nCr** command.

The **binompdf** command calculates the probability of exactly *x* successes in a given number of trials.

     binompdf(*# of trials*, *prob of success*, *x*)

The screenshot at the right displays both ways to calculate the probability.

If using Mathprint OS:

When students press ⌃ the cursor will move up to the exponent position instead of displaying ^ on the screen. They should enter the value of the exponent and then press ▸ to exit out of the exponent.

Discussion Questions:

- Discuss why the first formula works.

- How would you calculate the probability that at least 25 eggs hatch and live?

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 Cumulative Distribution Function** (**binomcdf)** command.

     binomCdf(*# of trials*, *prob of success*, *x*)

This command calculates the probability of at least *x* successes in a given number of trials. Directions for using the command are given on the worksheet.

Discussion Questions:

- What is the probability that more than 25 penguins survive and live?

- 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. This number should appear most often in the list. It can be found using the formula, $\mu = np$.

```
100*0.19
              19
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Students are to determine what the mean number of eggs that are expected to hatch. To determine this, they should multiply 100 times 0.19.

Homework

The student worksheet contains homework questions reinforcing the material from the activity.

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