Probability Distributions

ID: 8972

Activity Overview

In this activity, students list outcomes for probability experiments such as flipping a coin, rolling number cubes, and observing the sex of each child born in a family. They use these outcomes to record the values of random variables, such as number of tails, sum of the cubes, and number of boys. Students then create the histograms representing the distributions of the variable and complete a table listing the probabilities of each value.

An optional extension challenges students to create the probability histogram for an unfair number cube.

Topic: Discrete Random Variables

- *Graph the probability distribution of a discrete random variable given the probability associated with each element in the sample space over which it is defined.*

Teacher Preparation and Notes

- *Students should already be aware of basic probability theory and know that the probability of an outcome is between 0 and 1 inclusive.*

- *If needed, define and discuss the concept of discrete random variables before beginning the activity. Be sure to explain that in a probability distribution, the sum of the probabilities must be 1, as it contains all possible values of the variable.*

- ***To download the student and solution TI-Nspire documents (.tns files) and student worksheet, go to education.ti.com/exchange and enter "8972" in the keyword search box.***

Associated Materials

- *ProbDists_Student.doc*
- *ProbDist.tns*
- *ProbDist_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 Distribution (TI-84 Plus family) — 1952*
- *Makin' It Through The Winter (TI-84 Plus family) — 11936*
- *Why NP Min? (TI-Nspire technology) — 16933*

Problem 1 – Flipping a Coin

Step 1:   Students should move to page 1.3 and list the possible outcomes of flipping a coin two times, using **h** for heads and **t** for tails. In Column B, they need to enter the number of tails in each outcome.

Step 2:   Instruct students to advance to page 1.4 and create the probability histogram for the random variable *numtails*. To create the histogram, students should click below the *x*-axis, select *numtails* as the variable, and select **Histogram** for the **Plot Type** (**MENU > Plot Type**).
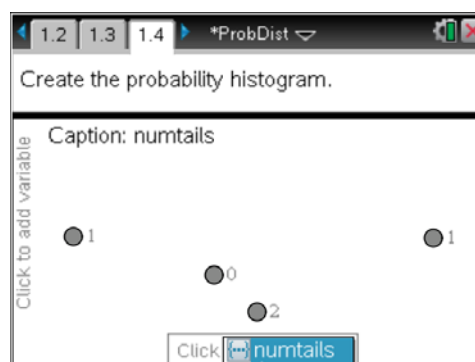
Students can change the vertical scale to Percent by pressing **MENU > Plot Properties > Histogram Scale > Percent**. To adjust the window, students can select **MENU > Window/Zoom** and use those options as desired. They can also change the widths of the bars by moving the cursor between bars or by grabbing and dragging the numbers on the axes.
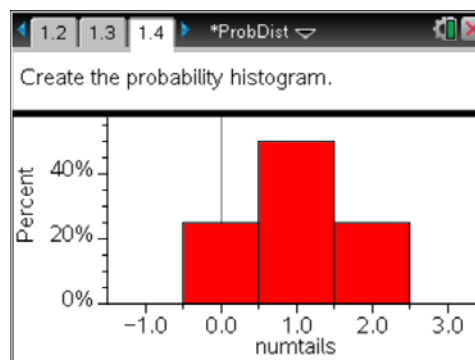
Step 3:   Students should now move to page 1.5 and complete the probability distribution by entering the probabilities for each value of the variable. They can enter the probabilities as percents, decimals, or fractions. Regardless of the format of their probabilities, the sum of the probabilities should be 1.

Problem 2 – Three Births

Step 1: Advancing to page 2.2, students should first list the possible outcomes of three births in Column A using **g** for a girl and **b** for a boy. There should be a total of eight outcomes. Then students need to list the number of boys in each outcome in Column B.

Step 2: Instruct students to create the probability histogram on page 2.3. They should be careful to choose *numboys* for the variable on the horizontal axis.
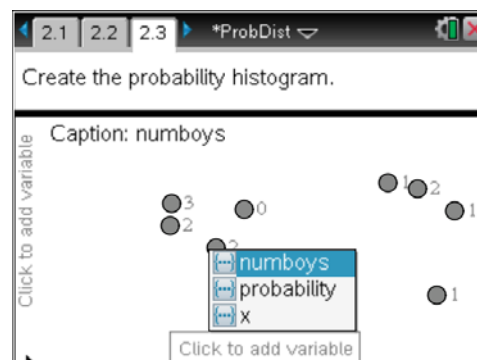
Again, students should change the vertical scale to Percent and adjust the bars so that there are no gaps between the bars.
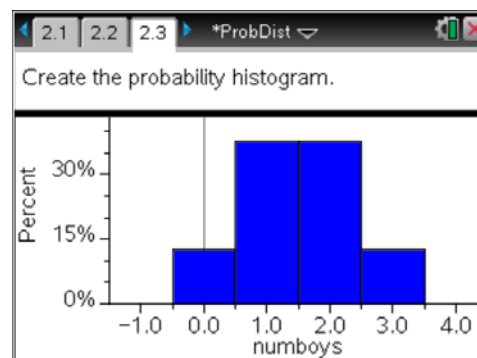
Step 3: Finally, students need to complete the probability distribution on page 2.4.

Problem 3 – Two Number Cubes

Step 1: On page 3.2, the outcomes of rolling two number cubes are listed. Ask students to name the values of the random variable *X*, where *X* is the sum of the two cubes (integers 2 through 12). Let them work independently to construct both the probability histogram and the probability distribution.
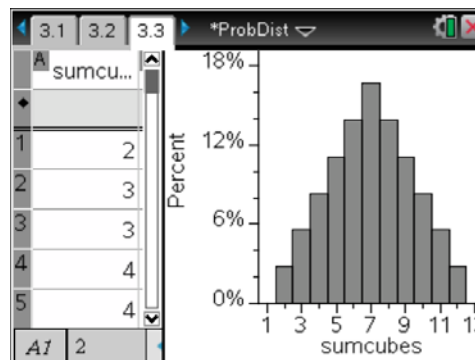
Step 2: Remind students that their probabilities must sum to 1.

If time permits, students can use their distribution to answer probability questions such as "*What is the probability of rolling a sum greater than or equal to 10?*" They can add individual probabilities by adding the values in the corresponding cells in their spreadsheet.
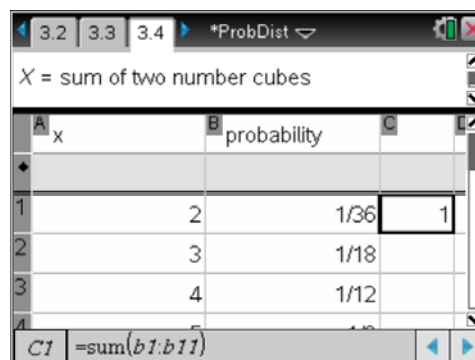
Step 3: Explain that in this activity, all of the probability distributions have been symmetric, but they do not have to be. They can also be uniform, which is the shape of the histogram for rolling one number cube, or for selecting a random digit from 0 to 9. You can have students create either of these by pressing `ctrl` + `I` to insert a new page.
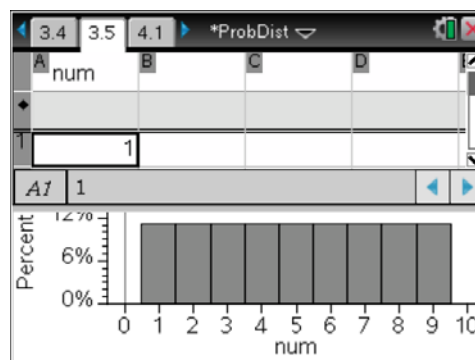
The histogram of a random variable can also be skewed to the left or right, or have no pattern at all.

Problem 4 – Extension

The extension challenges students to create the probability histogram and distribution for an unfair number cube; one in which the probability of rolling 6 is twice what it is for the other outcomes.

The probabilities are $\frac{1}{7}$, $\frac{1}{7}$, $\frac{1}{7}$, $\frac{1}{7}$, $\frac{1}{7}$, and $\frac{2}{7}$.