JMP® Introductory Lab Activities

Activity 6: Geometric Probability

Game: "No Ones Allowed," also called "The Game of Greed"

The object of the game is to remain standing as long as possible. Each round begins the same way with a student standing by his/her desk. The teacher rolls a die. If the roll is a 1, the first round is over and the student sits down. If the roll is anything else, the student remains standing and has succeeded in round one. The teacher rolls again and if the die comes up 1, the student sits down and is out. If any other number comes up the student remains in the game and has made it to round two.

Summary

How many times will the teacher roll the die until the student will need to sit down? JMP has a built in random number generator that can be used to simulate a number of probability distributions. In this lab, you will simulate data from a geometric probability distribution using the formula editor in JMP. In particular, you will simulate the number of rolls of a fair die until a 1 appears.

Use this document as a worksheet. Discussion questions for your report are in italics (at the end).

Instructions

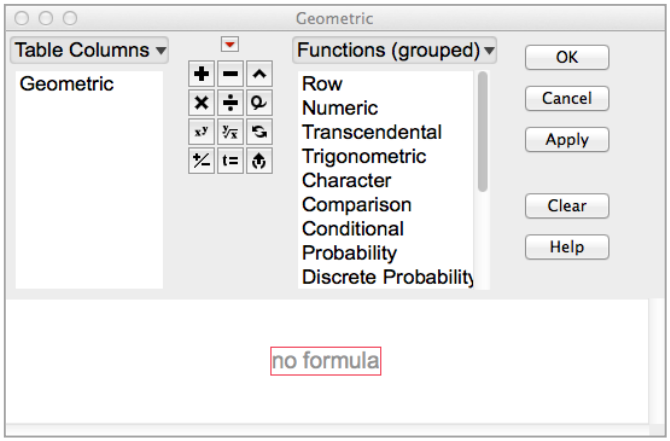
To simulate data from the geometric distribution:

1. Open JMP, and select **New Data Table** in the JMP Starter window (or select **File > New > New Data Table**).

2. Click on the top of Column 1, and change the name to Geometric.

3. Right click on the column **Geometric** and choose **Formula**.

   This opens the JMP formula editor, which has a list of table columns, a small keypad, a list of functions, and a screen for creating formulas.



4. Type a “1”, and then click “+”. Then, in the Function (grouped) list, scroll down and select **Random > Random Geometric**.

The JMP Random Geometric function returns values from 0 to *n.* In this particular problem zero will not be included; by adding a “1” before the formula, resulting possible values will be 1 to *n*.

5. Replace the “p” in the formula with “1/6”, then click **OK**. This is the probability of getting a 1 for this particular game.

6. Click on the red triangle for **Rows** (or used the Rows menu), and select **Add Rows**. Enter **50** as the number of additional rows to add and click **OK**.

The column will now have 50 rows of randomly generated data from a geometric distribution with probability of 1/6. Each row represents the number of tosses of a fair coin until a “1” appears.

Note: To simulate new data, click on the **gray triangle** next to the data table to open the tables panel. Then click on the **top red triangle** (next to “untitled”) and select **Rerun Formulas**.

To graph and summarize your simulated data:

1. Go to **Analyze > Distribution**. Select Geometric as the **Y, Column** and click **OK**.

JMP will provide a histogram and box plot for your simulated data. For the activities that follow, there are a few values of interest: the five-number summary and the mean.

Note that the mean should be near 6 since that is the expected value for a geometric distribution with probability 1/6.

2. To generate a **stem and leaf plot**, select the option from the **red triangle** next to **Geometric**. The stem and leaf plot can be used to calculate simulated probabilities in the activities.

Activity

1. Find the true probability for the following, where X is the number of trials before the first success (the number of trials before rolling a 1).

   Round to four decimal places. Show your work and complete formulae with substitution.

   P(X=1):_____ P(X=2) _____ P(X=3) _____

   P(X=4) _____ P(X=5) _____ P(X=6) _____

   P(X=7) _____ P(X=8) _____ P(X=9) _____

   Find the Mean _____

2. Using a sample of 25 simulated observations from a geometric distribution with p = 1/6, find the mean and the five-number summary from your distribution.

   Mean: _____

   Five-Number: _____ _____ _____ _____ _____

   Copy and paste your stem and leaf plot into your report. Calculate the simulated probabilities for numbers 1 through 9 from your sample of 25 observations. *Show your work.*

   P(X=1):_____ P(X=2) _____ P(X=3) _____

   P(X=4) _____ P(X=5) _____ P(X=6) _____

   P(X=7) _____ P(X=8) _____ P(X=9) _____

3. Using a sample of 100 observations, find the mean and the five-number summary from your distribution.

   Mean: _____

   Five-Number: _____ _____ _____ _____ _____

   Copy and paste your stem and leaf plot into your report. Calculate the simulated probabilities for numbers 1 through 9 from your sample of 100 observations. *Show work.*

   P(X=1):_____ P(X=2) _____ P(X=3) _____

   P(X=4) _____ P(X=5) _____ P(X=6) _____

   P(X=7) _____ P(X=8) _____ P(X=9) _____

4. Using a sample of 1,000 observations, find the mean and the five-number summary from your distribution.

   Mean: _____

   Five-Number: _____ _____ _____ _____ _____

   Copy and paste your stem and leaf plot into your report. Calculate the simulated probabilities for numbers 1 through 9 from your sample of 1,000 observations. *Show work.*

   P(X=1):_____ P(X=2) _____ P(X=3) _____

   P(X=4) _____ P(X=5) _____ P(X=6) _____

   P(X=7) _____ P(X=8) _____ P(X=9) _____

Write Your Report

In report form, summarize the relationship between the sample size and the accuracy of the estimated probabilities of the situation.

How does the size of the sample affect this accuracy? Be sure to refer to the true probabilities and the samples of 25, 100 and 1,000 observations.

Your report should include:

- *The stem and leaf plots from your simulation of 25, 100 and 1,000 observations.*
- *This worksheet with mathematical calculations clearly shown.*