

JMP INTRO® Lab Activities

Lab Activity - Geometric Probability

Game “No Ones Allowed”

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 desks. 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 1. 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 is in the game and has made it to at least two round.

In this lab you will create a geometric probability distribution using JMP INTRO the following are specific instructions to simulate this distribution.

1. Open JMP INTRO.
2. Click on the **New Data Table**
3. Double click on Column 1. *(You will see another window appear or you may have highlighted the column and you will only need to change the name)*
4. If another window appears under Column Name enter **Geometric**, then click **OK**. *(The column’s new name will be “Geometric”)*
5. Right click on Geometric and choose **Formula...** *(you will see a screen appear with table columns, a small calculator, functions (grouped) and a large white screen below)*
6. JMP INTRO has a built-in random number generator that follows a geometric distribution. It returns values from 0 to n . In this particular problem zero will not be included, by adding a “1” before the formula the resulting possible values will be 1 to n .
7. Type 1 and click the + sign from the displayed calculator and this will appear in the box.
8. Scroll down the Function (grouped) and click on **Random® Random Geometric**. *Inside your formula box you will see $1 + \text{Random Geometric}(p)$*
9. Replace the “p” with $1/6$ then hit **OK**. *(This is the probability of getting a one for this particular game)*
10. Click on the blue triangle to open the left side of the spreadsheet.
11. Click on the work “Untitled” and rename the worksheet **geometric** *(Do not click the red triangle but inside the word “Untitled”)*
12. Click on the **red triangle** by the worksheet title → **New Table Property** and name it “Refresh” *(You will see a screen appear showing name and value)*
13. In the value section which is the large white box below type **geometric<<eval formula** and then click **OK**
14. Click on the red triangle for **Rows® Add Rows...** enter 50 as the additional rows and click **OK** *(You will notice you now have in column 1 your have randomly selected data from a geometric distribution with probability of 1/6)*
15. Click **Analyze® Distribution** click **geometric** then **Y, Column** followed by **OK**
16. You will now have a histogram and boxplot for your particular data set. Notice that there are only a few values of interest: the five number summary and the mean. Note also that

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

17. It will be easier if you use the stem and leaf plot to find your counts. Use the red triangle next to **Geometric® Stem and Leaf**. (*This will show your stem and leaf with the counts on the side.*)

Activity – Write in complete sentences

1. Find the true probability for the following (round to four decimal places)
Show complete formula with substitution

One _____ Two _____ Three _____ Four _____ Five _____

Six _____ Seven _____ Eight _____ Nine _____

Find the Mean _____

2. Using a sample of 25 observations from a geometric distribution with $p = 1/6$, find the mean and the 5 number summary from your distribution

Mean _____

5 Number _____

- a. Copy your stem and leaf plot. From your sample of 25 observations calculate the simulated probabilities for numbers 1 thru 9. (*Show work with correct mathematical notation for answer*)

3. Using a sample of 100 observations find the mean and the 5 number summary from your distribution

Mean _____

5 Number _____

- a. Copy your stem and leaf plot. From your sample of 100 observations calculate the simulated probabilities for numbers 1 thru 9. *(Show work with correct mathematical notation for answer)*

4. Using a sample of 1000 observations find the mean and the 5 number summary from your distribution

Mean _____

5 Number _____

- a. Copy your stem and leaf plot. From your sample of 1000 observations calculate the simulated probabilities for numbers 1 thru 9. *(Show work with correct mathematical notation for answer)*

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 the true probabilities and the samples of 25, 100, and 1000 observations.

- Your report should include the stem and leaf plots from your simulation of 25, 100, and 1000 observations.
- Your report should also include this worksheet with mathematical calculations clearly shown

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Teacher Notes

Lab Activity - Geometric Probability

Objective: The students will simulate the geometric probability using JMP INTRO. They will further investigate how the size of the sample has an impact on how close we reach the true probability.

Time required: 45 minutes

Prerequisites:

- Students understand how to find the true probability of a geometric distribution.
- It is important that before this distribution is simulated on JMP INTRO that the students have played the game in class. They need to understand the rules of the game and have an intuitive idea of the time required to win.

JMP INTRO Notes:

- The students that are not comfortable with the computer may have difficulty when they are entering a script formula.
- When completing the directions for #7 be sure they use the “+” from the program and not their keyboard.
- On number 13 when giving instructions make sure they type `geometric<<eval` formula with the necessary spacing between eval and formula and do not use quotations.
- This can easily be changed to a Binomial Probability with a change in the directions from #6. Instead of choosing Geometric choose Binomial. The directions can easily be adapted for a binomial distribution.

Concept Notes:

- The purpose of this activity is to simulate a large sample of a distribution quickly. The student can easily change the sample size and calculate the simulated probability quickly. Be sure to use this opportunity to explain how as the sample size becomes larger the student will have a clearer picture of the true probability. Often in statistics we do not know the true probability of a situation. In this activity the student can easily calculate the true probability and compare it to samples of various sizes.
- It is imperative that the student knows how to calculate the true probability using the geometric formula before attempting this activity.

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Answer Key

Suggested answers for Geometric Probability

1. X = the number of trials before the first success

$P(X=1)$.1666	$P(X=2)$.1389	$P(X=3)$.1157
$P(X=4)$.0965	$P(X=5)$.0804	$P(X=6)$.0670
$P(X=7)$.0558	$P(X=8)$.0465	$P(X=9)$.0388

Mean is 6

2. Answers will vary depending on output
3. Answers will vary depending on output
4. Answers will vary depending on output

The student report should include comment showing how the larger sample will be more accurate and produce a more accurate distribution.