Problem 1 – Introduction

In a **Geometric Distribution**, the random variable counts the number of times until a success happens. It has the following properties.

1. A trial has two options either success or failure. P(success) = p
2. Each trial is independent.
3. The variable of interest is the number of trials required to obtain the first success.

Problem 2 – Simulation

Roll a die. What is the probability that it takes four rolls to roll the first 6?

To investigate this, on page 2.2 use the *Calculator* application to enter **randInt(1, 6)** until the number 6 appears. Count the number of rolls it took and record it in the spreadsheet. Repeat for a total of 10 simulations.

- What is your experimental probability that the first 6 appeared on the fourth roll?

Record the numbers of the other member's of your group with your numbers. Then view the dot plot on page 2.5.

- What is your group's experimental probability that the first 6 appeared on the fourth roll?

Problem 3 – Investigation

What is the theoretical probability that the first 6 appears on the fourth roll?

To investigate this, begin with find the theoretical probability of the first 6 appearing on the first roll, then the second, and so on. Use page 3.2 to complete the following chart.

Number of Rolls	Exact Probability	Approximation
1		
2		
3		
4		
10		

- What is the probability of the first 6 appearing on the nth roll?

Use the spreadsheet on page 3.5 to find the theoretical probability of the first 6 appearing on the first roll to the one-hundredth roll.

In the formula bar of Column A, enter **=seq(x,x,2,100,1)**. This will list integers from 1 to 100.

In the formula bar of Column B, enter **=geompdf(1/6, a[ ])**. This will calculate the probabilities.

- How do your calculations from page 3.2 compare to the values in the spreadsheet?

- The scatter plot of probabilities vs number of rolls is graphed on page 3.7. What can you conclusions can you draw about the probability of the first 6 appearing as the number of rolls increases?

- Add a regression line to your graph (**MENU > Analyze > Regression > Show Exponential**). How does the regression equation relate to your theoretical probability? Show how you know.

- In this activity the probability of success was $p = \frac{1}{6}$. What is the general formula for any value of *p*?

Problem 4 – Expected Value

The expected value of a distribution is defined as the sum of the probability an outcome multiplied by the payoff. In this example, the payoff is the number of rolls.

Use the spreadsheet on page 4.2, to calculate the expected value of this activity.

- What is the expected value? What does it represent in the context of the problem?

Extension – More or less

1. What is the probability that it will take *less than* 4 rolls to obtain a six?

2. What is the probability that it will take *more than* 4 rolls to obtain a six?