Discrete Random Variables: Lab I*

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Abstract

This module allows students to explore concepts related to discrete random variables through the use of a simple playing card experiment. Students will compare empirical data to a theoretical distribution to determine if the experiment fist a discrete distribution. This lab involves the concept of long-term probabilities.

Class Time:
Names:

1 Student Learning Outcomes:

- The student will compare empirical data and a theoretical distribution to determine if everyday experiment fits a discrete distribution.
- The student will demonstrate an understanding of long-term probabilities.

2 Supplies:

- One full deck of playing cards

3 Procedure

The experiment procedure is to pick one card from a deck of shuffled cards.

1. The theorectical probability of picking a diamond from a deck is: _____
2. Shuffle a deck of cards.
3. Pick one card from it.
4. Record whether it was a diamond or not a diamond.
5. Put the card back and reshuffle.
6. Do this a total of 10 times
7. Record the number of diamonds picked.
8. Let X = number of diamonds. Theoretically, $X \sim B($_____, _____$)$

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4 Organize the Data

1. Record the number of diamonds picked for your class in the chart below. Then calculate the relative frequency.

x	Frequency	Relative Frequency
0	_____	_____
1	_____	_____
2	_____	_____
3	_____	_____
4	_____	_____
5	_____	_____
6	_____	_____
7	_____	_____
8	_____	_____
9	_____	_____
10	_____	_____

Table 1

2. Calculate the following:
   a. $\overline{x} =$
   b. $s =$
3. Construct a histogram of the empirical data.

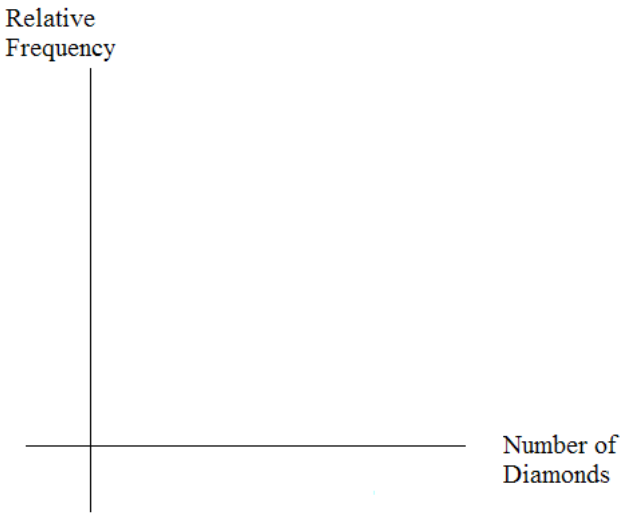

Figure 1

5 Theoretical Distribution

1. Build the theoretical PDF chart based on the distribution in the Procedure section above.

x	$P(x)$
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Table 2

2. Calculate the following:
   a. $\mu =$_____
   b. $\sigma =$_____
3. Construct a histogram of the theoretical distribution.

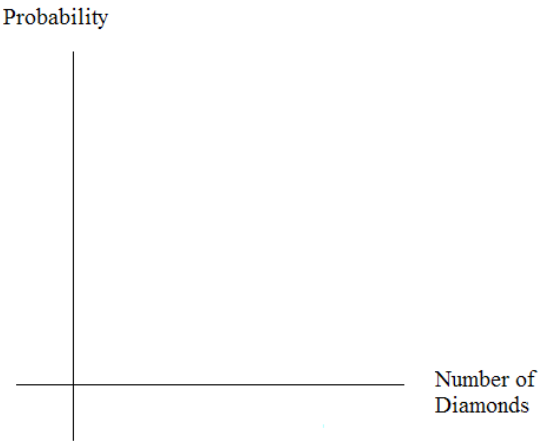

Figure 2

6 Using the Data

Calculate the following, rounding to 4 decimal places:

NOTE: RF = relative frequency

Use the table from the section titled "Theoretical Distribution" here:

- $P(x = 3) =$
- $P(1 < x < 4) =$
- $P(x \geq 8) =$

Use the data from the section titled "Organize the Data" here:

- $\text{RF}(x = 3) =$
- $\text{RF}(1 < x < 4) =$
- $\text{RF}(x \geq 8) =$

7 Discussion Questions

For questions 1. and 2., think about the shapes of the two graphs, the probabilities and the relative frequencies, the means, and the standard deviations.

1. Knowing that data vary, describe three similarities between the graphs and distributions of the theoretical and empirical distributions. Use complete sentences. (Note: These answers may vary and still be correct.)
2. Describe the three most significant differences between the graphs or distributions of the theoretical and empirical distributions. (Note: These answers may vary and still be correct.)
3. Using your answers from the two previous questions, does it appear that the data fit the theoretical distribution? In 1 - 3 complete sentences, explain why or why not.
4. Suppose that the experiment had been repeated 500 times. Which table (from "Organize the data" and "Theoretical Distributions") would you expect to change (and how would it change)? Why? Why wouldn't the other table change?