Roll a distribution

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# Overview of lesson

The purpose of this lesson is to allow the students to discover that data collected in seemingly similar settings will yield distributions that are shaped differently. Students will roll a single die 30 times counting the number of face up spots on the die and recording the result each time as a histogram or a histogram. Students will be asked to describe the shape of the distribution. Combining work with several students will yield more consistent results. Students will then roll two dice and add the results together. Do this 30 times and plot the sums as a histogram. Combine results with several students to yield more consistent results. Describe the distribution. Now roll a die until you get a 6. Count the number of die rolls it took to get the 6. Record the results in a histogram. Do this process 10 times. Describe the shape of the distributions.

# CCSS

CCSS.Math.Content.6.sp.a.2

CCSS.Math.Content.6.sp.a.3

CCSS.Math.Content.6.sp.b.4

CCSS.Math.Content.6.sp.b.6

CCSS.Math.Content.6.sp.b.5d

# Prerequisites

Students should have prior knowledge of creating histograms (see histogram vs. bar graph in the AMP Network for a quick review activity) as well as how to read the results of a die roll. They should know how to find the median, mean and range of a data set.

# Learning targets

Students will be able to discover that distributions come in many shapes and this lesson should expose them to uniform, mound-shaped/symmetric, and right skewed.

# Time required

Approximately one class period.

# Materials required

Two six sided die for each student. It is also suggested that you have a shoebox or a lid to a box for the students to roll in as this will alleviate the dice hitting the floor.

# Lesson Details

Begin the lesson by asking the class to picture in their minds the distribution that would result from recording the number of 1s, 2s, 3s, 4s, 5s, and 6s that they get when they roll a die. If they roll a die 60 times about how many of the outcomes should be a 1 or a 2 etc. and what will a graph of this data look like? Now have them roll the die and start recording the number in a histogram. They can work in pairs where one student rolls the die and announces the outcome to the data recorder. Have them combine their work with another pair of students so they have a total of 120 die rolls. Now have them describe the distribution by its shape, outliers, center and spread (SOCS). It should be fairly uniform. There will be no outliers. Have them tell you what they believe the mean and median to be just from looking at the graph. You can have them find the median by counting into the distribution until they find the 60th observation. Have them record the number of 1s 2s 3s 4s 5s and 6s and find the average by multiplying the number of outcomes times their weight and dividing by the number of trials (120). And now find the range of the data.

Now have the students roll two dice and add the results of the dice together to get a number from 2 through 12. Do this 30 times and record the observations in a histogram. Combine your work with another pair of students to create 60 observations and combine the histograms. Make note of how many 2s, 3s, etc there were. Now have the students describe the distribution by its SOCS. The shape should be mound shaped and symmetric. There should be no outliers. Have them find the center of the distribution by eye, just look at the distribution and see where the center appears to be. Then have them find the center by finding the median and record this on their histogram. After counting the number of 2s, 3s, etc. find the mean by multiplying the number of outcomes times their value of the dice and add those results together and divide the sum by 60 to get the average die roll.

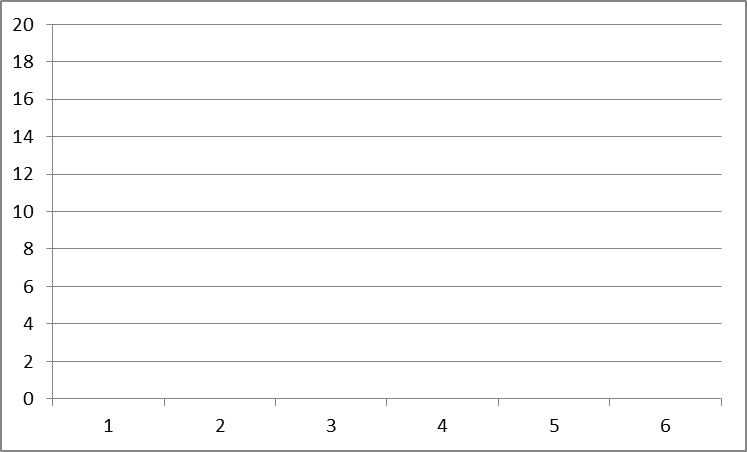
Now have them roll a die until they get a 6. They must keep track of the number of attempts until the 6 is rolled. If they get lucky they will get the 6 on the first die roll but they may have to try many times. They need to keep track closely of how many rolls there were until the 6 is achieved and make note of this number. Then do it again. Since this could take a while have them work in teams of 4 where every member of the team is recording their own die rolls until they all have rolled the 6 15 times. As they are working on this you can ask them to think about what the average outcome will be. On average, how many die rolls will it take to get a 6? Now combine their work together to make a single histogram with the 60 observations just created. Describe this distribution again by its SOCS. They should be able to find the median. They should find the mean by the same method we used in the previous exercises. This would be a good time to note the shape of the distribution. It should be right skewed and they can now compare the median to the mean. In the previous two distributions the mean and the median were fairly close together. In this distribution the mean is probably larger than the median as there should be some skew. The mean is not a resistant measure and you can ask the students why they think the mean and the median are not the same. This discussion should lead to the idea that the mean will be affected by the outliers while the median is not. Tell the students you were very unlucky when you were doing this for yourself and one time it took you 100 rolls before you got a 6. Ask them to add this to their graph. Does it appear to be an outlier? What effect did this outcome have on the median?(none) What effect did this have on the mean? Have the students calculate the new median and mean. Discuss the idea that the skew will pull the mean in the direction of the skew while the median will not be pulled.

Roll a distribution

# Student Handout

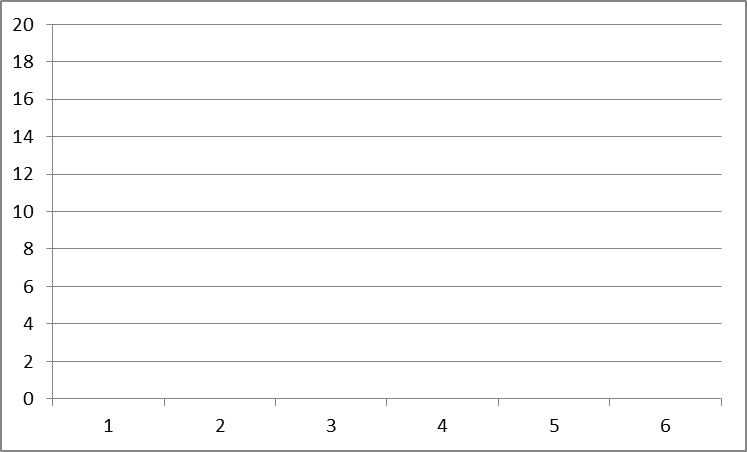
# Exercise A

1. Imagine rolling a 6-sided die 60 times and recording the results in a histogram. What shape will this distribution take? In the space below create your imaginary histogram.



0 1 2 3 4 5 6

1. Now roll your die 60 times and record the actual results in the space provided to create your distribution.



0 1 2 3 4 5 6

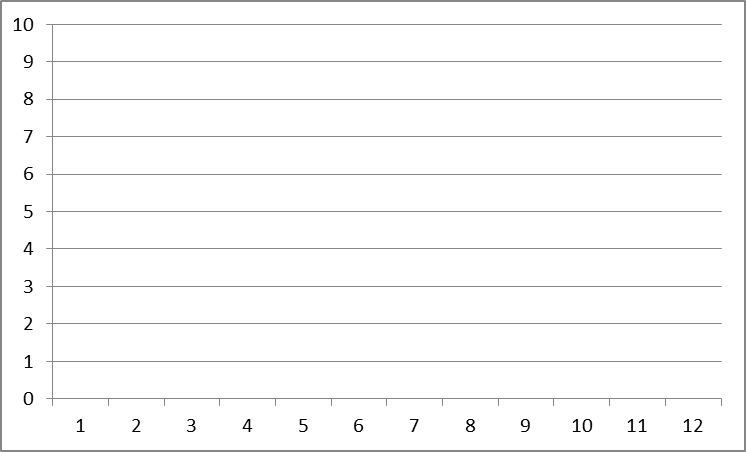
1. Now combine your results with those of your partners to create a more complete picture of the distribution.

0 1 2 3 4 5 6

1. How did the combined histogram compare to the histogram that you made by yourself?
2. How did the combined histogram compare to your imaginary histogram made in problem 1?
3. Calculate the mean of the distribution.
4. Calculate the median of the distribution.

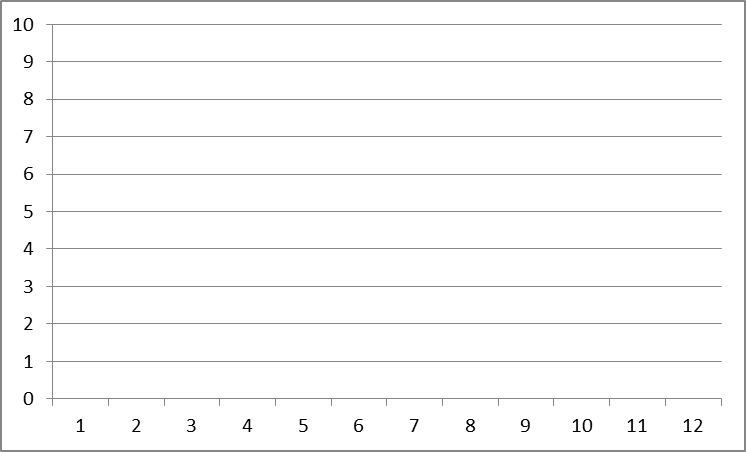
# Exercise B

1. Imagine rolling 2 dice and adding the results together. Example if you roll a 2 and a 1 that sums to 3. If you roll a 5 and a 6 that sums to 11. What shape will this distribution take? In the space below create your imaginary histogram.



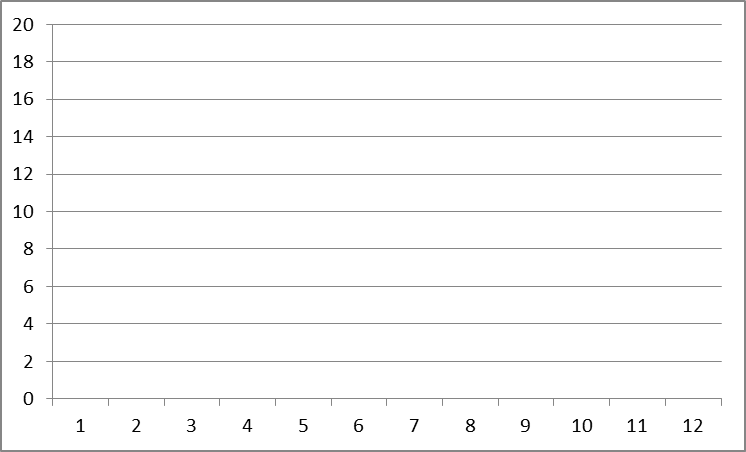
0 1 2 3 4 5 6 7 8 9 10 11 12

1. You will now actually roll 2 dice and add the results of the two die together. Roll the two dice and sum the results 30 times and record each sum in the histogram below.



0 1 2 3 4 5 6 7 8 9 10 11 12

1. Describe the distribution by its shape, the presence of any outliers, the center and the spread.
2. Now combine your results with your partners and create another histogram for the combined data in the space below.



0 1 2 3 4 5 6 7 8 9 10 11 12

1. Describe the distribution by its shape, the presence of any outliers (unusual event(s)), the center and the spread.
2. Calculate the mean of the distribution
3. Calculate the median of the distribution
4. Describe any similarities or differences in the histogram in Exercise A and the histogram in Exercise B

# Exercise C

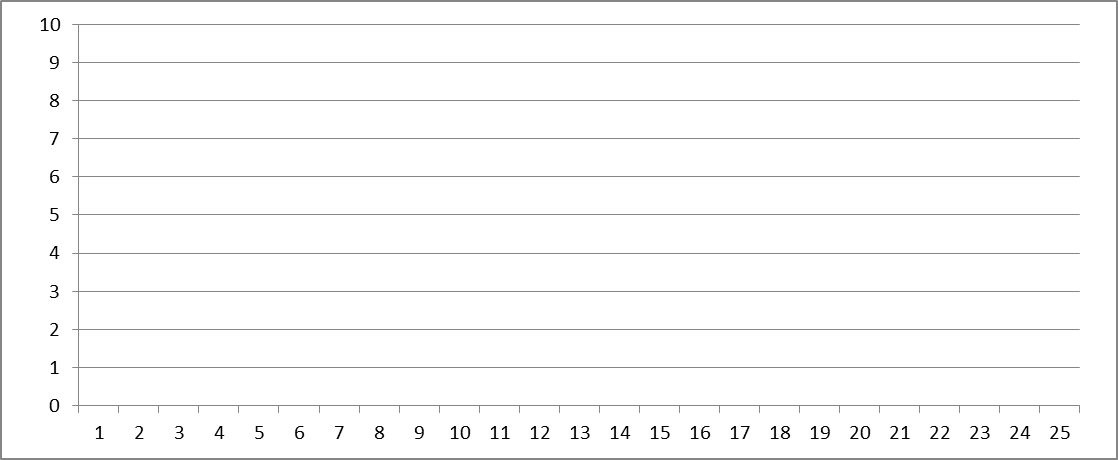
1. Roll a die until you roll a 6. The variable of interest is the number of die rolls necessary until the 6 was rolled. Record the result.
2. Repeat the above process described in #1 above 15 times recording the number of trials necessary in the table below.

|  |  |
| --- | --- |
|  | Number of rolls needed to get a 6 |
| Trial 1 |  |
| Trial 2 |  |
| Trial 3 |  |
| Trial 4 |  |
| Trial 5 |  |
| Trial 6 |  |
| Trial 7 |  |
| Trial 8 |  |
| Trial 9 |  |
| Trial 10 |  |
| Trial 11 |  |
| Trial 12 |  |
| Trial 13 |  |
| Trial 14 |  |
| Trial 15 |  |

1. Now combine your work with your partners to get a more complete picture and record your combined results in the table below.

|  |  |
| --- | --- |
|  | Number of rolls needed to get a 6 |
| Trial 16 |  |
| Trial 17 |  |
| Trial 18 |  |
| Trial 19 |  |
| Trial 20 |  |
| Trial 21 |  |
| Trial 22 |  |
| Trial 23 |  |
| Trial 24 |  |
| Trial 25 |  |
| Trial 26 |  |
| Trial 27 |  |
| Trial 28 |  |
| Trial 29 |  |
| Trial 30 |  |

1. Make a histogram for this combined data with each dot representing the number of die rolls needed to roll a 6.



0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

1. Calculate the mean of the distribution.
2. Calculate the median of the distribution.
3. Is the mean greater than or less than the median?
4. What effect do you think the shape of the distribution had on the value of the mean in comparison to the median?
5. Compare and contrast the three different histograms you created in Exercise A, Exercise B and Exercise C. How are they alike and how are they different?
6. If you had to use the words Uniform, Mound Shaped, or Right skewed to describe the three distributions which term would you apply to each distribution.
7. Note the value of the mean and the median in the plots from Exercises A and B. How are plots A and B alike but C is different. Why do you think that happened?