Straighten up and Fly Right!

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# Overview of lesson

The purpose of this lesson is to allow the students gather data in a fun way and answer a statistical question through analysis of the data. Students will fly paper airplanes and analyze the data to determine which style of plane flies longer.

# CCSS

CCSS.Math.Content.

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| 6.SP.A.2  Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape.  6.SP.A.3  Recognize that a measure of center for a numerical data set summarizes all of its values with a single number, while a measure of variation describes how its values vary with a single number.  6.SP.B.4  Display numerical data in plots on a number line, including dot plots, histograms, and box plots.  6.SP.B.5  Summarize numerical data sets in relation to their context, such as by:  6.SP.B.5a  Reporting the number of observations.  6.SP.B.5b  Describing the nature of the attribute under investigation, including how it was measured and its units of measurement.  6.SP.B.5c  Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered.  6.SP.B.5d  Relating the choice of measures of center and variability to the shape of the data distribution and the context in which the data were gathered. |

# Prerequisites

Students should know how to construct histograms, box and whisker plots, find measures of center and spread.

# Learning targets

Students will apply what they have learned about statistics to answer a statistical question: Which style of plane flies for a longer time?

# Time required

Approximately one class period.

# Materials required

* One plane for every 3 students in the class
* Accurate stop watch for each team of 3. (If your students have phones they will have a stop watch on it.)

# Lesson Details

Outline:

1. Begin the lesson by showing both styles of paper airplanes. They look very similar to each other and they might not notice the difference. Point out that one style has a flat nose and the other has a bent nose.
2. Ask the students if the slight modification to the plane to create the second style will change the flight characteristics of the plane.
3. Experimental Design: Tell the students that they are responsible for throwing the plane and recording how long the plane stays in the air. Since we are recording duration of the flight have a discussion with the students about any sources of variation that they should control. For example, what if one group throws their plane off of a balcony while another group throws their plane from the ground. Allow the students to explore any ideas they think are important and come up with a set of rules for everyone to follow. Basically, you have to have the throwers toss the planes with the same force and from the same height to try to be as consistent as possible. Try to get the students to see the importance of control in an experiment.
   1. During this discussion your students might even discover the idea of a matched-pairs experiment where they would toss the plane without the nose bent and then fold up the nose and toss the plane again to see if the flight characteristics changed. This is an excellent experimental design but would require more planes and the repeated folding of the nose causes the planes to fly poorly after just a few tosses but it could be done if you wanted to make many more planes!
4. Find a good place on campus to throw the planes with few obstructions and hopefully sheltered from the wind. Have each team toss their plane and record the flight times. Each team should have at least 5 flights or enough flights so we can have at least 25 flight times for each plane when we combine the data.
5. Return to your class and have students post their times on the board in two columns, one for the flat nosed plane and one for the bent nose plane. Now have your students construct histograms, box plots and summary statistics for the two different styles of planes. Allow each team to present their findings and encourage discussion about their results.

\*\*\***Do not panic if there is not a significant difference between the planes**. Allow the students to explore the data and most importantly have fun with the lesson! If you have time and your students came up with the idea of a matched pairs experiment it could be fun to extend the lesson to that!

# Sample Results

Your students will produce 20 or more flights with the Bent Nose plane and 20 or more with the standard nose plane. This is an example of work done by a student.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Bent nose | 5.2 | 4.9 | Blunt nose | 6 | 3 | 2.5 |
| 4.8 | 5.4 | 6.5 |  | 3.8 | 2.5 | 3 |
| 4.5 | 4 | 3.2 |  | 2.9 | 2.5 | 1.8 |
| 3.5 | 2.7 | 5.2 |  | 5.9 | 4.8 | 3.2 |
| 7 | 6.8 | 3.9 |  | 2.2 | 2.5 | 3.2 |
| 5.5 | 3.5 | 6.2 |  | 2.9 | 3 | 2.8 |
| 7.5 | 7 | 6.8 |  | 3.2 | 3.8 | 3.5 |
| 2.9 | 5 | 5.2 |  | 4 | 4.5 |  |

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| These are the summary statistics for the bent nose plane. |  |
| These are the summary statistics for the blunt nose plane |  |
| The histogram shows the data for the bent nose plane is approximately symmetric with no outliers. The center of the distribution is approximately 5 seconds and the range is 4.8 seconds |  |
| The histogram shows the distribution of times for the blunt nose plane is right skewed with a center at approximately 3.4 seconds and a range of 4.2 seconds |  |
| The boxplots show the relationship between the two planes. The distributions are clearly different. The blunt nose plane would have had a roughly symmetric distribution if not for the two outliers. The mean of the blunt nose plane is being increased by the two outliers which makes the two planes appear to be more similar than they actually are. If we compare the means the difference between the two planes is only 1.7 seconds but if we compare the medians the planes are 2.2 seconds apart. It is fairly clear that the bent nose plane performed better than the blunt nose. The bent nose plane’s minimum flight time was above the first quartile for the blunt nose, its median was greater than almost all of the flight times for the blunt nose plane excluding the two outliers and its 3rd quartile was greater than all of the times for the blunt nose plane. | C:\Users\daddy\Desktop\SCREEN01.BMP |
| If the goal is to increase the flight times of the plane then the modification appeared to have the desired effect. However, there appears to be a cost in consistency. The bent nose plane had more variation and a larger range in the data. You can see the IQR of the blunt nose plane is only 1.3 seconds but the IQR for the bent nose plane is twice as large at 2.6 seconds. |  |