Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date:\_\_\_\_\_\_\_\_\_\_\_\_

**Paper Airplane Flight**

Goal: The students will use their knowledge of standard deviation to compare and interpret a spread of data sets.

Objective: Given colored sheets of paper students will make three different types of paper airplanes. Then students will measure the distance each airplane goes in at least 4 trials, record the data, and interpret the results by calculating the standard deviation to determine which plane build is most consistent.

Materials:

* Sheets of colored paper
* Measuring tape
* Masking tape
* Calculator

The Experiment

There are many ways to fold a piece of paper into a paper airplane. Most people have a build that they think flies the best or the furthest. Let’s find out which plane build is most consistent by using the standard deviation.

The Steps

1. Build 3 *different* paper airplane models and label them A, B, and C.
2. Pick a launch point on the floor and put a piece of masking tape on it labeled “launch.”
3. Stand on the launch tape and throw the first model paper airplane five times. After each throw, measure the distance it landed from the launch tape.
4. Repeat this process for each model paper airplane and record the data in the data table below.
5. Calculate the average distance traveled for each model paper airplane.

I predict that paper airplane \_\_\_\_\_\_\_\_ will be the most consistent.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Distance in Trial 1** | **Distance in Trial 2** | **Distance in Trial 3** | **Distance in Trial 4** | **Distance in Trial 5** | **Average Distance** |
| **Plane A** |  |  |  |  |  |  |
| **Plane B** |  |  |  |  |  |  |
| **Plane C** |  |  |  |  |  |  |

Now that we have our data, we want to determine which plane build is the most consistent. Here is the formula for finding the standard deviation.

$$σ=\sqrt{\frac{1}{N}\sum\_{i=1}^{N}(x\_{i}-μ)^{2}}$$

Let’s break this formula down into steps so that we get a better understanding of what each variable means. Use the following chart to compute the standard deviation for each type of paper airplane.

|  |  |  |
| --- | --- | --- |
| **Plane A** | **Plane B** | **Plane C** |
| Average Distance: $μ$= | Average Distance: $μ$= | Average Distance: $μ$= |
| Next we need to subtract the mean from each individual x-value, and square it. |
| $$(x\_{i}-μ)^{2}$$(\_\_\_\_\_-\_\_\_\_\_$)^{2}$=(\_\_\_\_$)^{2}$=\_\_\_\_(\_\_\_\_\_-\_\_\_\_\_$)^{2}$=(\_\_\_\_$)^{2}$=\_\_\_\_(\_\_\_\_\_-\_\_\_\_\_$)^{2}$=(\_\_\_\_$)^{2}$=\_\_\_\_(\_\_\_\_\_-\_\_\_\_\_$)^{2}$=(\_\_\_\_$)^{2}$=\_\_\_\_(\_\_\_\_\_-\_\_\_\_\_$)^{2}$=(\_\_\_\_$)^{2}$=\_\_\_\_ | $$(x\_{i}-μ)^{2}$$(\_\_\_\_\_-\_\_\_\_\_$)^{2}$=(\_\_\_\_$)^{2}$=\_\_\_\_(\_\_\_\_\_-\_\_\_\_\_$)^{2}$=(\_\_\_\_$)^{2}$=\_\_\_\_(\_\_\_\_\_-\_\_\_\_\_$)^{2}$=(\_\_\_\_$)^{2}$=\_\_\_\_(\_\_\_\_\_-\_\_\_\_\_$)^{2}$=(\_\_\_\_$)^{2}$=\_\_\_\_(\_\_\_\_\_-\_\_\_\_\_$)^{2}$=(\_\_\_\_$)^{2}$=\_\_\_\_ | $$(x\_{i}-μ)^{2}$$(\_\_\_\_\_-\_\_\_\_\_$)^{2}$=(\_\_\_\_$)^{2}$=\_\_\_\_(\_\_\_\_\_-\_\_\_\_\_$)^{2}$=(\_\_\_\_$)^{2}$=\_\_\_\_(\_\_\_\_\_-\_\_\_\_\_$)^{2}$=(\_\_\_\_$)^{2}$=\_\_\_\_(\_\_\_\_\_-\_\_\_\_\_$)^{2}$=(\_\_\_\_$)^{2}$=\_\_\_\_(\_\_\_\_\_-\_\_\_\_\_$)^{2}$=(\_\_\_\_$)^{2}$=\_\_\_\_ |
| Now we need to find the mean of those squared values for each plane. |
| Mean of Squared Values =\_\_\_\_\_\_\_ | Mean of Squared Values =\_\_\_\_\_\_ | Mean of Squared Values =\_\_\_\_\_ |
| Lastly, we need to take the square root of each of these mean values to find the standard deviation for each type of paper airplane. |
| Square Root = $\sqrt{ }$= \_\_\_\_\_\_So, $σ=$\_\_\_\_\_\_\_\_ | Square Root = $\sqrt{ }$= \_\_\_\_\_\_So, $σ=$\_\_\_\_\_\_\_\_ | Square Root = $\sqrt{ }$= \_\_\_\_\_\_So, $σ=$\_\_\_\_\_\_\_\_ |

Now that we’ve calculated the standard deviation for each type of paper airplane, we need to decide which build is the most consistent. In order for a build to be considered consistent we want to find the one that has most numbers close to the average distance. To interpret the standard deviations, we need to remember that a higher standard deviation means that the numbers are more spread out, and a lower standard deviation means that most of the numbers are very close to the average.

The plane with the most consistent build in plane \_\_\_\_\_\_\_\_\_, because \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Extension

Now that we have looked at the standard deviation for each plane build and the average distance for each plane build, which do you think is better and why?

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