

**Video:** [**https://youtu.be/iGxgsY02kLs**](https://youtu.be/iGxgsY02kLs)

**Video Summary:**

How do companies ensure that the fliers they create and cut are the correct length? It is important to make sure the fliers are cut at the correct length as they come off the roll of printing. In this video, you will see how companies can use sets of actual data to see how accurate their cutting machines are to the correct length. You will find the mean and the deviation of the data.

**EMT International - Biography**

EMT International has been in business for over 80 years starting as a tool and die manufacturer transforming into a full service Engineering and Manufacturing company producing its own line of finishing equipment that serves the digital and offset printing industry producing equipment for OEM's such as HP, Canon/Oce, Screen, Kodak, Xerox, Ricoh and Pitney Bowes in addition to the largest print producers in the world.  Our business is headquartered in Hobart, WI with a sales office in Chicago IL and employs ~140 skilled team members.

**Common Core Mathematical Content Standards:**

**6.SP.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.5.c:** Summarize numerical data sets in relation to their context, such as by: giving quantitative measures of center (median and/or mean) and variability (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.

or

**HS.S-ID.2:** Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more data sets.

**HS.S-ID.3:** Interpret differences in shape, center, and spread in the context of data sets, accounting for possible effects of extreme data points (outliers).

**Common Core Mathematical Practice Standards:**

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Model with mathematics.

**Teacher note:** *Please preview the entire video and pre-work solutions in order to anticipate students’ needs, misconceptions and materials unique to your classroom.*

The student work page at the end of the lesson will give students a place to jot down ideas and work through answers as they are following along with the video.

**Pre-Activity Discussion**

Question to ask students: How do coupons or fliers get printed? How does the company ensure that the fliers are the correct length? How can we use statistics to help verify that the coupons are the correct length and are accurate in length?

Discussion: Coupons and fliers are printed on a large continuous roll of paper. They are then put into the cutting machine, which cuts the paper at specific length. When testing a machine’s cutting accuracy, the company will measure a stack of papers to create data. They will then use this data to find the mean length of the paper, and the deviation of the data to determine how accurate the lengths are. The larger the spread of the deviation, the less accurate the cutting machine.

**Part 1**

* Play Video (0:00-0:52), pause at (0:52) to answer the discussion questions.
* The employees are trying to calculate the average length of a stack of paper that has been cut on the machine. Their goal is to have the average length of the stack be as close to 11 inches as possible. During this section of the video, you can see them measuring the length of the paper on a Microview Inspection Table. This reads the measurement and then they can input the length into a spreadsheet for calculations. Students should find the mean of the data and also the deviation of the data (middle school: mean absolute deviation or high school: standard deviation). As a teacher, you can decide to have them graph the data as well to see a visual of the center and spread of the data.
* Have students work through this problem. Discuss methods and answers as necessary.
* Answers:

|  |  |
| --- | --- |
| Mean | 11.053 |
| MAD | 0.10043 |
| Standard Dev. | 0.133112054 |
| 3\*σ | 0.399336162 |

**Part 2**

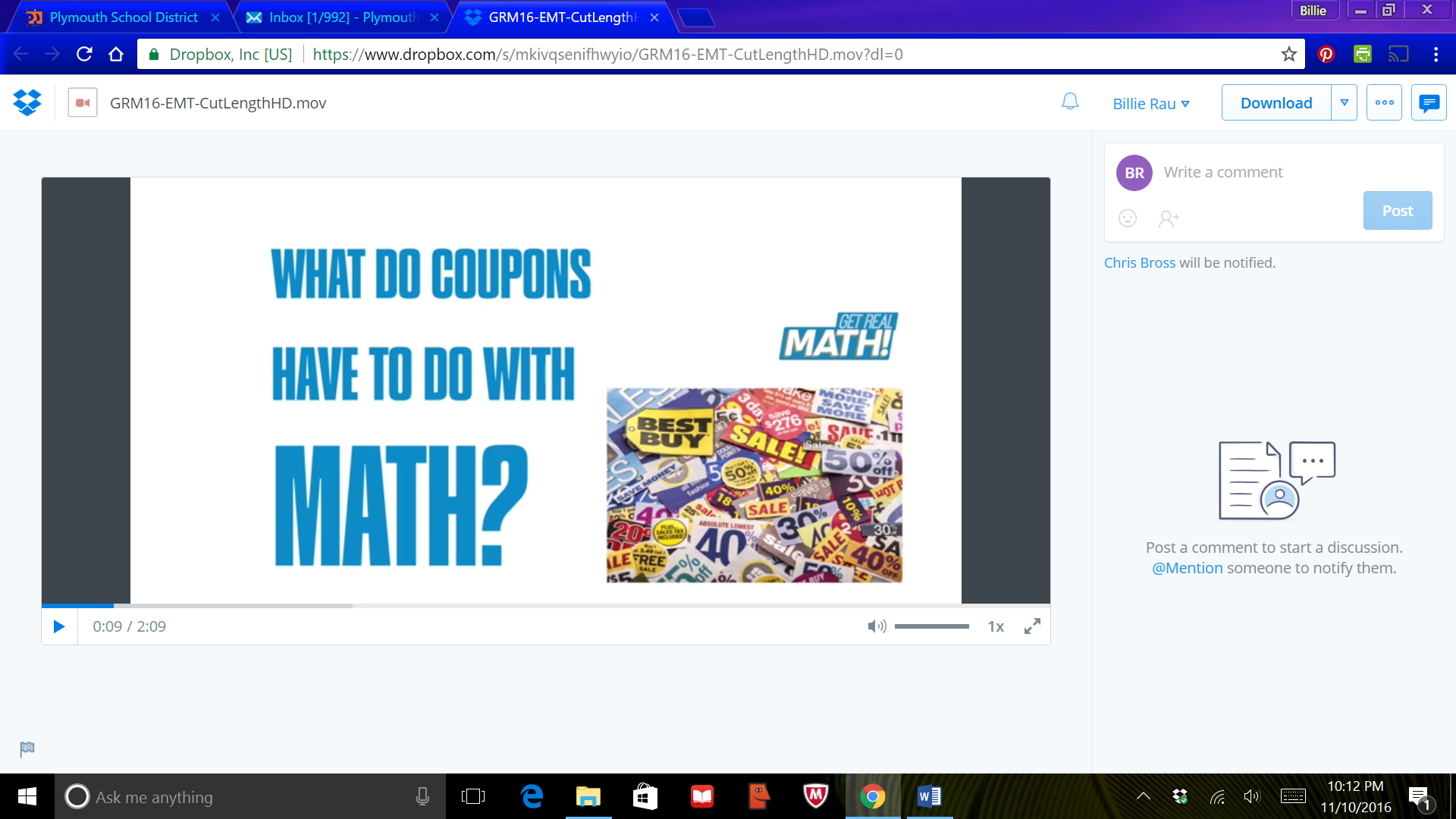
* Play Video (0:53 – 1:29), pause at (1:29) to answer the discussion questions.
* Now that the machine has been fixed, students can find the mean and deviation of the new set of data. Students should find the mean of the data and also the deviation of the data (middle school: mean absolute deviation or high school: standard deviation). As a teacher, you can decide to have them graph the data as well to see a visual of the center and spread of the data.
* Have students work through this problem. Discuss methods and answers as necessary.
* Answers:

|  |  |
| --- | --- |
| Mean | 10.980 |
| MAD | 0.0322 |
| Standard Dev. | 0.041745585 |
| 3\*σ | 0.125236755 |

**Part 3**

* Play Video (1:30 – 2:09).

Student Work Page



Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Part 1**

Calculate the mean and deviation of the data for Trial 1.

**Part 2**

Calculate the mean and deviation of the data for Trial 2.

|  |  |  |  |
| --- | --- | --- | --- |
| Sheet Length Data 11" sheet | | | |
| **Trial 1** | | | |
| Sample # | Meas. length (in) |  |  |
| 1 | 11.060 |  |  |
| 2 | 10.800 |  |  |
| 3 | 11.340 |  |  |
| 4 | 10.900 |  |  |
| 5 | 10.800 |  |  |
| 6 | 10.830 |  |  |
| 7 | 10.920 |  |  |
| 8 | 10.895 |  |  |
| 9 | 11.200 |  |  |
| 10 | 11.145 |  |  |
| 11 | 11.270 |  |  |
| 12 | 10.850 |  |  |
| 13 | 11.315 |  |  |
| 14 | 10.930 |  |  |
| 15 | 11.240 |  |  |
| 16 | 11.260 |  |  |
| 17 | 10.800 |  |  |
| 18 | 11.270 |  |  |
| 19 | 11.040 |  |  |
| 20 | 11.070 |  |  |
| 21 | 10.995 |  |  |
| 22 | 11.040 |  |  |
| 23 | 11.195 |  |  |
| 24 | 11.180 |  |  |
| 25 | 11.230 |  |  |
| 26 | 11.130 |  |  |
| 27 | 11.050 |  |  |
| 28 | 11.015 |  |  |
| 29 | 11.010 |  |  |
| 30 | 11.080 |  |  |
| 31 | 11.075 |  |  |
| 32 | 11.000 |  |  |
| 33 | 11.035 |  |  |
| 34 | 11.030 |  |  |
| 35 | 10.995 |  |  |
| 36 | 11.042 |  |  |
| 37 | 11.052 |  |  |
| 38 | 11.005 |  |  |
| 39 | 10.915 |  |  |
| 40 | 11.024 |  |  |
| 41 | 11.000 |  |  |
| 42 | 10.980 |  |  |
| 43 | 11.065 |  |  |
| 44 | 11.135 |  |  |
| 45 | 10.995 |  |  |
| 46 | 11.185 |  |  |
| 47 | 11.050 |  |  |
| 48 | 11.040 |  |  |
| 49 | 11.090 |  |  |
| 50 | 11.100 |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| Sheet Length Data 11" sheet | | | |
| **Trial 2** | | | |
| Sample # | Meas. length (in) |  |  |
| 1 | 10.885 |  |  |
| 2 | 11.075 |  |  |
| 3 | 10.975 |  |  |
| 4 | 10.980 |  |  |
| 5 | 10.895 |  |  |
| 6 | 10.925 |  |  |
| 7 | 10.960 |  |  |
| 8 | 11.020 |  |  |
| 9 | 10.970 |  |  |
| 10 | 11.000 |  |  |
| 11 | 10.995 |  |  |
| 12 | 11.040 |  |  |
| 13 | 10.975 |  |  |
| 14 | 10.990 |  |  |
| 15 | 10.985 |  |  |
| 16 | 10.945 |  |  |
| 17 | 10.940 |  |  |
| 18 | 10.965 |  |  |
| 19 | 10.975 |  |  |
| 20 | 10.935 |  |  |
| 21 | 10.965 |  |  |
| 22 | 10.975 |  |  |
| 23 | 10.995 |  |  |
| 24 | 10.935 |  |  |
| 25 | 11.045 |  |  |
| 26 | 10.995 |  |  |
| 27 | 10.985 |  |  |
| 28 | 11.060 |  |  |
| 29 | 10.970 |  |  |
| 30 | 10.965 |  |  |
| 31 | 10.990 |  |  |
| 32 | 11.030 |  |  |
| 33 | 11.045 |  |  |
| 34 | 10.975 |  |  |
| 35 | 10.965 |  |  |
| 36 | 10.950 |  |  |
| 37 | 10.945 |  |  |
| 38 | 10.940 |  |  |
| 39 | 10.935 |  |  |
| 40 | 11.015 |  |  |
| 41 | 10.985 |  |  |
| 42 | 11.010 |  |  |
| 43 | 11.030 |  |  |
| 44 | 10.950 |  |  |
| 45 | 10.995 |  |  |
| 46 | 10.975 |  |  |
| 47 | 11.035 |  |  |
| 48 | 11.025 |  |  |
| 49 | 11.010 |  |  |
| 50 | 10.895 |  |  |