EDUC501 OP13 G62 SM11 CTA Mathematics

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Lesson Plan 4 – Statistics – Day 2

­TITLE: **Day 2 Statistics: “Mean of Absolute Value”**

CONTEXT OF LESSON/PRE-REQUISITE KNOWLEDGE: (See Statistic Day 1 Lesson)

* + This is the second lesson in the Statistics unit. Students have reviewed and can calculate measures of central tendency and understand it as a description or value of a set of data.
  + Students have been introduced to statistical variability and understand that it is the spread or dispersion of a data set.

LEARNING OBJECTIVES and ASSESSMENT: (See Statistic Day 1 Lesson for complete list of unit objectives)

* Given data, including data in a real-world context, students will calculate and interpret the mean absolute deviation of a data set.
* Students will identify that descriptive statistics (mean absolute deviation, standard deviation, etc.) may include measures of center and dispersion.
* Students will understand that variance, standard deviation, and mean absolute deviation measure the dispersion of the data.
* Students will identify that the sum of the deviations of data points from the mean of a data set is 0.

RELATED 2009 VIRGINIA STANDARDS OF LEARNING:

* **SOL A.9**: *The student, given a set of data, will interpret variation in real-world contexts and calculate and interpret mean absolute deviation, standard deviation, and z-score.*

MATERIALS NEEDED:

* Graphic Calculator
* Computer with internet accessibility and data projector or document camera
* Statistic Unit Organizer (double sided, with expanded unit map on back) – *from Day 1 lesson*
* Handout for each student: ““Mean Absolute Deviation” *[Attached files: mad.pdf & mad-a.pdf]*

implementation:

* Warm-up/Review Activity: (10 minutes)

Review Questions:

* + - *Say*: “We know from yesterday’s lesson that statistics can be used to describe data and we use measures of central tendency to describe the middle of a set of data” *Ask*: What are the measures of central tendency? Which ones describe the middle or average of a set of data?” (*answers: mean & median).*
    - *Say*: “Yesterday we looked at mean as a balance point. We will now take a look at what you remember with today’s warm-up activity. “

A student has the following grades on her tests. What score will she need to balance her grade or for her scores to have a mean of 85?

* Test scores: 83, 80, 72, 91, 97
* Show this problem as a representation of Balance Point for Mean. What score is needed to balance? Answer: 87 (85 +2 = 87)

**-20 18 (+2) = 20**

-13 -5 -2 6 12

X x x ? x x

70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97

**Sum of the deviation: -20 + 20 = 0 (balance point for mean)**

**Mean (85) + deviation (+2) = 87**

**Mean = 85;** 85 \* 5 = 510; 72 + 80 + 83 + 91 + 97 = 423; 510 – 423 **= 87**

Engagement Activity: (10 minutes): *Write problem on board or use data projector to show.*

* Present the following scenario:
  + The students of Miss Edward’s Journalism Club are interested in how many hours they spend watching television in one week. They collected the following data:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 3 | 8.5 | 9 | 9 | 12.5 | 14 | 16.5 | 18 | 19 | 20.5 |

* Ask the students to think about what they can do with the data. Give them 5 -10 minutes to come up with their results. Some will choose to represent it graphically, find the mean, median, mode, or range, etc.
* Have students share what they chose to do with the data.
* After each shared idea, question the students about what the graph or statistics says about the information.

*Example:*

* + - What does the mean (range, mode, or median) tell us about the data?
    - What does the line plot or the histogram show us about the data?
* As you discuss their results, emphasize that mean, median, and mode are measures of central tendency and range is a measure of dispersion or the spread of data.
* Tell students that another way to measure dispersion of data is to compare the elements (values of data set) to the mean.
* Ask students to summarize what they learned yesterday about how they can associate mean in a data set. They should state that mean is the balance point, the center of the deviations.

Direct Instruction: (30 minutes)

* Ask students to help you find the deviation of each element from the mean, or the distance each element in the data is from the mean.
* Ask students how they would find this deviation. Their response should be: subtract the mean from each value [value – mean].
* Create a chart on the board to show the values/elements (from Miss Edward’s Journalism Club activity) on one side and a column for the deviation from the mean [value – mean]. Record the mean beside the chart, using the symbol µ (mu) for the mean.

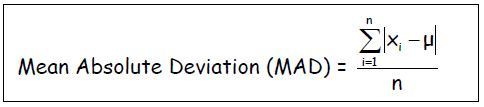
Mean: *Answer* Mean: 13

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| x | x - µ | | x - µ | |  | x | x - µ | | x - µ | |
| 3 |  |  | 3 | -10 | 10 |
| 8.5 |  |  | 8.5 | -4.5 | 4.5 |
| 9 |  |  | 9 | -4 | 4 |
| 9 |  |  | 9 | -4 | 4 |
| 12.5 |  |  | 12.5 | -.5 | .5 |
| 14 |  |  | 14 | 1 | 1 |
| 16.5 |  |  | 16.5 | 3.5 | 3.5 |
| 18 |  |  | 18 | 5 | 5 |
| 19 |  |  | 19 | 6 | 6 |
| 20.5 |  |  | 20.5 | 7.5 | 7.5 |
|  | Sum of the deviations: | http://infinity.cos.edu/faculty/woodbury/Stats/Tutorial/IMG00116.GIFSum of deviation using the absolute values: |  | Sum of the deviations:  0 | http://infinity.cos.edu/faculty/woodbury/Stats/Tutorial/IMG00116.GIF  Sum of deviation using the absolute values:  46 |

Mean Absolute Deviation = 46/10 = 4.6



*Example of summation notation:*

* Have the class help you fill in the chart.
* You may want to take time to review the calculator steps with the students.
* Ask students to calculate the average distance from the mean or average deviation.
* Discuss their observation that the sum of the deviations is zero, so the average distance from the mean or average deviation is zero.
* Ask the students if this will always occur and why or why not. Point out and discuss the activities from yesterday, if needed. Students should conclude that this, the average distance from the mean or average deviation, will always be zero because of the negative values.
* Ask the students how they can ensure that a number (any number) is always positive?
* Continue the discussion until the idea of absolute value emerges.
* Have students find the absolute value of the deviations and then find calculate the sum of the deviations. Consider showing the students ways to shorten the process by using stat button on the calculator. (Reference “Statistic Calculator Steps” handout given at CTA or website: <http://mathbits.com/MathBits/TISection/Statistics2/dispersion.htm>
* Ask the students how they would now find the mean of the sum of absolute deviations. With their understanding of mean, they should state that you will need to find the average by dividing the sum by the number of values (elements): 46/10 = 4.6
* Introduce students to the name for this descriptive statistic: “Mean of Absolute Deviation” (MAD). It is the average of the distances between the data plots and the mean of the set.
* Ask the students to calculate the “mean absolute deviation”: the average distance from the mean or the average deviation.
* Ask students to summarize how they found the mean absolute deviation.
* Introduce the students to the formula below and have them discuss how it matches what they did to calculate the mean absolute deviation and their summary of the process.

Where µ represents the mean of the data set, n represents the number of elements in the data set, and x1 represents the ith element of the data set.

* Additional information about the sigma notation and the mean absolute deviation formula is available on line: <http://mrsgalgebra.pbworks.com/w/page/28191161/Mean-Absolute-Deviation> (see attached) & http://teachers.henerico.k12.va.us (see attached).
* Ask students what the mean absolute deviation could tell them about the data. What would a high mean absolute deviation indicate? What about a low value for the mean absolute deviation?
* Divide the students back into the groups that they had yesterday.
* Ask them to look at the graphs from yesterday and decide within their groups which graphs show data values that differ the least from the mean value, 16 and which show data values that differ the most from the mean value, 16?
* Ask them to also discuss in their groups what they observe about the spread of the data? Does one of the graphs have more data spread out? Does one graph have more data clustered around the mean? Can they quantify the spread of the data?
* After a 3-5 minutes of discussion in their groups, have students discuss what observations and inferences they can make about the graphs. Have the students order the graphs from least variability to greatest variability. Some students may make a connection to the sum of the distances as the indicator of the variability, while others may determine the variability by the visual representations (forming subjective ordering, which many student may find it difficult to agree upon a final order). Further the conversation by encouraging them to make a connection by characterizing the clusters around the mean, the spread, gaps, peaks in the center, or peaks that are far from the mean.
* Guide the students to recognize that the sum of the distances can be used to quantify the spread of the data and that the sum of the distance from the mean is related/connected to the concept we studied today - Mean Absolute Deviation (MAD). Remind them that deviation from the mean = value – mean (the difference between each data value and the mean).

WRAP-UP ACTIVITY/ASSESSMENT: (15-20 minutes)

* Activity 3: “Mean Absolute Deviation” *[Attached files: mad.pdf & mad-a.pdf]*  (15-20 minutes)
* Distribute worksheet: “Mean Absolute Deviation” (attached)
* Have students work in their groups/teams (Pair-and-Share style) and complete this worksheet. Recognize the first team completes the assignment.
* Review the answers together, having the students to take notes and to write down details, if needed.
* Have the students identify the mean absolute deviation (MAD) formula at the top of the worksheet and describe steps to find MAD, tell you what they are calculating when they find the MAD of a data set, and what each symbol of the formula means. Recognize each team with a point if a member of their team contributes to the summary discussion.
* Through questioning and discussion, guide them to fill in their “Statistics Expanded Unit Map” (*from Day 1 lesson)* under the “Variability” circle to include: Mean Absolute Deviation (MAD). Include the formula and steps to calculate MAD (if needed).

MEETING THE NEEDS OF ALL STUDENTS THROUGH DIFFERENTIATION:

* This lesson may require more than one day to complete due to the complexity of the topic. If several students are absent or if students’ behavior interferes with the pacing of the lesson, consider adjusting or breaking the assignment into a two day activity and spend more time on vocabulary and calculations.
* Throughout the lesson discuss and show the students the symbols used in the various statistics formulas so that they become familiar with the symbolic language.
* Post the formulas and a key to briefly describe each symbol.
* Have students refer to their Statistic unit organizer frequently and add notes as needed. Have them include computation steps for MAD, including calculator steps.
* Have a slotted outline of the unit organizer available for students with special needs.
* If needed, adjust your student teams/groups to ensure that you have at least one strong student leader that can provide peer tutoring.
* Repeat and clarify important concepts, trying to simplify and make connects with previously discussed concepts.
* Use small data sets in your calculations.

WHAT COULD GO WRONG WITH THIS LESSON **AND** WHAT WILL YOU DO ABOUT IT?

* This lesson involves a lengthy direct instruction session. It is important to incorporate short breaks/movement or ways to vary the activities so that special need students can stay focused and engaged throughout the lesson.
* Informal assessment questions are incorporate throughout the lesson. Use the students’ responses to guide your pacing and instruction.

CONNECTION TO CTA: (See Statistic Day 1 Lesson)





