

RAFT IDEAS

Topics: Statistics, Average (Mean, Median, Mode), Outlier

Materials List

- ✓ Pens or pencils
- ✓ Scratch paper
- ✓ Measuring tapes and/or meter/yard sticks
- ✓ Doll
- ✓ Tape or pins
- ✓ Optional: White board and pens

This activity can be used to teach:

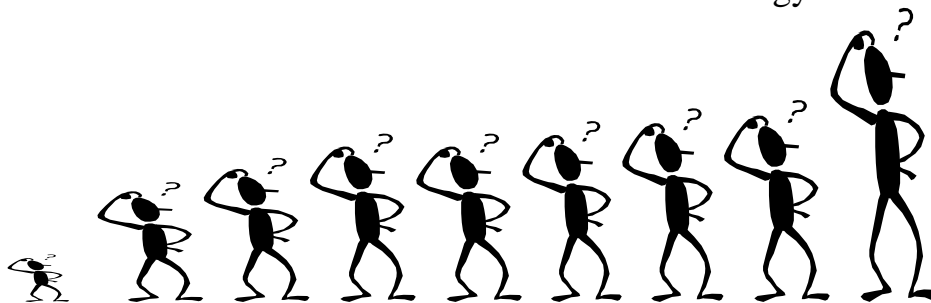
- Probability Distributions, Samples, & Models (Common Core Math Standards: Statistics & Probability, Grade 6, 1-4; Grade 7, 1-4)
- Problem Solving and Reasoning (Common Core Math Standards: Mathematical Practices Grades 4-12)



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Who is The Outlier?

Become familiar with statistical terminology



Engage students in a fun way to overcome barriers of new vocabulary by applying statistical terms and analysis to readily available data in and around the classroom.

To Do and Notice (Best for class of 20 or more)

1. Have students work in pairs or small groups to measure their heights and write the values in centimeters or inches on pieces of paper. Select one type of unit for the whole class; mixing up units will yield strange results!
2. Measure the height of the doll, write down the value, and attach the paper to the doll. The teacher also records his or her height.
3. Line up the students, teacher, and doll in order of least to greatest height.
4. Record the heights in the same order as the line. Optional: record values on a white board. If two or more people have the same height, create a column listing the value as many times as it occurs. Students sit down once their height has been recorded.
5. Teacher divides students into groups of 2-3. Each small group calculates following statistics of the class height data including the teacher and the doll:
 - Mean: the sum of the values in the data set divided by the number of values.
 - Median (50%): the middle value when the values in the data set are arranged in numerical order.
 - Mode: the value that occurs most often in the data set
 - Range: the difference between the greatest and the least values of the data set.
 - LQ (Lower quartile or 25%): the middle value of the lower half data set.
 - UQ (Upper Quartile or 75%): the middle value of the upper half data set.
 - IQR (Inter Quartile Range): the difference between UQ and LQ.
 - Outlier: any number that appears to deviate markedly from other members of the sample in which it occurs. Sometimes defined as any number that is not between the range of $(UQ + 1.5 \cdot IQR)$ and $(LQ - 1.5 \cdot IQR)$.
6. When the groups are ready and/or after about 15 minutes, bring the groups together and compare answers for each of the calculated statistical parameters. If answers differ, have each group review the steps they took to get their answer. Have one representative from each group go over the steps required to obtain each of the answers.
7. Finally, have all the students line up again in order of least to greatest value. Call out each parameter in the list with its answer and have the student(s) closest to that answer take 1 step forward.
8. Are there significant differences between Mean, Median and Mode? Which value would best represent the height value of the class?
9. Are there any outliers? Is that surprising?
10. Are there any other unexpected data or statistics that are now evident?

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The Math Behind the Activity

Statistics is a branch of mathematics that deals with the collection, organization, analysis, and interpretation of numerical data. Each day when students read the newspapers or magazines, watch television, listen to the radio, or surf the internet, they are bombarded with numerical information about the national economy, sports, politics, and so on. Interpreting this data is important to students understanding of the world around them.

Students often think that the study of statistics is not useful to them on a personal level. When students work with data that has personal meaning to them such as height, student allowances, salary ranges for occupations in which they are interested, or the performance of a favorite athlete, it is easier for them to develop an appreciation of the usefulness and power of statistics.

Consider the following data set of height values and the corresponding statistical parameters:

| Height example | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|--|----|----|----|----|----|----|----|----|----|----|----|----|
| Height values in inches (ordered data) | 24 | 55 | 57 | 57 | 60 | 62 | 65 | 66 | 67 | 68 | 69 | 70 |

| | | |
|----------------------------|------|--|
| Sum of all data values | 720 | |
| Number of data points | 12 | |
| Mean | 60 | the sum of all the data values divided by the number of data points |
| Median (50%) | 63.5 | the middle value when all the data values are arranged in numerical order. In case of an even number of data points, take the average of the middle two points to get the median value |
| Mode | 57 | the number that occurs most often in the data set |
| Range | 46 | the difference between the greatest and the least value |
| UQ (Upper Quartile or 75%) | 67.5 | the middle value of the upper half data set. |
| LQ (Lower Quartile or 25%) | 57 | the middle value of the lower half data set. |
| IQR (Inter Quartile Range) | 10.5 | the difference between UQ and LQ. |
| Outlier Upper Limit | 83.3 | $UQ + 1.5 * IQR$ |
| Outlier Lower Limit | 41.3 | $LQ - 1.5 * IQR$: one data point (i.e. 24) is an outlier! |

Taking it Further

- Use other readily available data in and around the classroom such as students' shoe size, number of pets, travel distance to school, number of siblings in the family, etc.
- Create a box-and-whisker plot, which is a graphical representation of a five statistical summary (Minimum; LQ or 1st Quartile; Median or 2nd Quartile; UQ or 3rd Quartile; Maximum) – see **Web Resources**.

Web Resources (Visit www.raft.net/raft-idea?isid=598 for more resources!)

- Quartiles and Box and Whisker Plots - <http://www.regentsprep.org/regents/math/algebra/AD3/boxwhisk.htm>
- Box-and-Whisker Plots - <http://www.purplemath.com/modules/boxwhisk.htm>
- Box Plot - <http://www.shodor.org/interactivate/activities/BoxPlot/>
- Teacher designed math courses from the New Jersey Center for Teaching & Learning – <https://njctl.org/courses/math>