YuMi Deadly Maths

Year 7 Teacher Resource:

SP – Give it your best shot

Prepared by the YuMi Deadly Centre
Faculty of Education, QUT

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YuMi Deadly Maths Year 7 Teacher Resource: **SP – Give it your best shot**

ACKNOWLEDGEMENT

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refined and presented in professional development sessions.

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Year 7 Statistics and Probability

Give it your best shot

Learning goal	Students will calculate the mean, median and mode for sets of data and select the appropriate measure of centre.
Content description	Statistics and Probability – Data representation and interpretation • Calculate mean, median, mode and range for sets of data. Interpret these statistics in the context of data (ACMSP171) • Describe and interpret data displays using median, mean and range (ACMSP172)
Big idea	Statistics and Probability – interpretation vs construction, measures of central tendency and divergence
Resources	Shot-puts, tape measures, four shot-put fields, rulers or chopsticks, statistic cards, number line (rope and pegs or masking tape on floor), rolls of paper streamers (not crepe paper)

Reality

Local knowledge	Discuss the selection process of choosing representatives to enter inter-school athletics carnivals. *How is the best person/s chosen for an event?* [trials]. *What happens in the trial process?* [A number of trials take place and the person/s with the best and most consistent result is chosen.] *Where do we see the process of trials happening in our world?* [sports carnivals: school, district, state, national]. *Where have you seen data published?* [newspaper, TV, online]. *What data is published there?* [Olympic medals, weather, money].
Prior experience	*If we wanted to gather **information** about the students in our class, e.g. hair colour, eye colour, shoe size, **how could this data be shown?*** [list, table, graph]. Today we will explore how we can find and compare centre points in lists of data.
Kinaesthetic	Have four shot-put fields marked out on the oval. Divide students into four groups to run shot-put trials in the four areas. Each student has four attempts; each throw is measured by others in the group and recorded on paper by the student throwing the shot-put.

Abstraction

Body

Task: From the four results in the trials, students find the length that represents their typical throw. *How would you describe the length of your four throws? Were they all the same? What will the selector look at in deciding who had the best throws of the shot-put?* [They will look at each person's typical throw by taking all their throws into account – longest, shortest, every throw.] *How could you use your bodies to determine your typical throw?* [Discuss answers]. Have students take one step for each metre thrown, rounding to the nearest half: mark the start with a ruler, walk each length and place a ruler or chopstick at the end of each throw's length, add the lengths to get a cumulative total, place another ruler or chopstick at the end. Divide the total steps by four and walk the steps of that length. Place a different coloured ruler to mark the typical length of their throws. (Each student will need six rulers or chopsticks, one being a different colour to mark the typical throw as distinct from the four actual throws.)

Explore this set of statistic cards: 4.8 m, 4.4 m, 4.7 m, 4.8 m, 4.1 m, 4.6 m, 4.8 m. In a range of 40–50, peg these cards in order on the rope number line. (This can also be done with cards on a masking tape line on the floor.) *Suppose these lengths were one student's throws of the shot-put. What will you do to find the typical throw?* [Add the total lengths together, count the number of attempts, divide by the count.] *Does anyone know the term or terms given to the typical result?* [average or mean]. *The average or mean is one of the measures of centre in a group of statistics.*

What do you notice about these statistics? [4.8 m was thrown three times whereas the

others were thrown only once.] *Does anyone know the term that refers to this type of repeated statistic?* [mode]. *Where would it be very important to know the mode, or objects that are occurring repeatedly?* [shop – ordering more of the goods that sell quickly, groceries, books, pharmacist, cars, TV shows]. *The mode is another measure of centre as the mode is the statistic that is repeated more than once or the statistic that is repeated most frequently. The statistics cluster around this one statistic as it is repeated so frequently.*

What length sits in the middle of all the throws? What did you do to find this? [Arrange in order, lowest to highest, count how many throws there are, halve them or divide by 2. This gives the number either side of the one in the centre: 4.7 m.] *Does anyone know the term that refers to the type of statistic that is found in the middle of an ordered group?* [median]. *The median is a measure of centre as it sits in the middle or centre when all the statistics are arranged in order, lowest to highest*.

What are the three measures of centre? [mean, median, mode].

What would happen to the mean if one of your bank saving deposits was very much higher than the others, e.g. $4, $7, $3, $25, $6? (Arrange these in order on the number line.) *What is the mean of your deposits?* [$9]. *How has the one higher deposit affected the mean or average?* [It has made the mean higher than each of the other four deposits.] Examine the effect on the mean when a very much lower value is included, e.g. *A worker is paid on a casual basis of number of hours worked per day. One week included a day when the worker went home sick, so in that week they received the following daily amounts: $240, $220, $235, $245, $40* (cards arranged in order on the number line). *What was the mean daily wage for the week*? [$196]. *What effect did the one low wage have on the mean?* [It dragged the mean back towards the lower wage so that the mean wasn't even in the $200s and was less than each of the other amounts.] *Is the median affected in either of these examples?* [No, the median is always the statistic in the middle/centre of the statistics arranged in order.] *What measure, mean or median, is more stable or robust and why?* [The median is more stable or robust because its position never changes from the middle order of all the statistics and so gives a good idea/sense of the centre point of all the statistics. It is not affected so much by unusual statistics, whereas the mean can be greatly affected by these, leaning disproportionally closer to the higher or lower statistic in the group.]

Hand

Each student takes a roll of paper streamer: Mark off each shot-put throw on the roll of paper streamer with a pencil line to denote the length of each throw using 1 cm for each metre thrown. Cut off the total length of all throws so that the four throws are in one continuous length of paper.

Discussion: *What would you do with the paper streamers to find the typical throw or even up all the throws to the same length?* [Fold the whole into halves, then fold the halves into quarters and then measure the length of one quarter.] *What process was used to find the typical length using the paper streamers? What did you do first?* [put them all together]. *What operation is that?* [addition]. *What was the next step?* [folded the whole length into four equal pieces, quarters]. *What operation was that?* [division]. Describe the whole process. [Add all the lengths together and then divide the sum of the lengths by how many lengths there were, four.] *What is the term or terms given to evening up the different statistics so that they are all the same?* [finding the average or mean]. *What process is used to find the mean?* [Add all statistics together, count the statistics and divide the total by the count.]

How will you find the median? [Arrange the statistics in order, lowest to highest, and find the one in the middle or centre.] *What did you find?* [There is no one statistic in the middle because there is an even number of throws.] *What number would be halfway between the two in the centre? How will you find this number?* [Find the average of the two middle numbers – add the two numbers and halve the result. That then becomes the median.]

Did your set of statistics have a mode? How do you find the mode? [Look for the statistic that is repeated the most.]

Mind

Visualise a set of three numbers where the mean will be 8. Visualise a different set of five numbers where the median is 8. Now visualise a set of six numbers where the mode is 8. See these numbers in your mind: 10, 5, 15. What is the mean? What is the median? Is there a mode? Visualise a set that has 7, 6, 5, 7, 8. What is the mode?

Creativity

Students create their own sets of statistics to demonstrate mean, median, mode. They may include some unusual values in these.

Mathematics

Language/ symbols

statistics, data, set, list, table, graph, average, mean, median, mode, measure of centre

Practice

The best introductory activities are those that enable the students to intuitively understand mean, median and mode. Below are some examples. Choose the ones more appropriate to your students. It is not necessary to do them all – only those that are needed.

1. Straws or strips. Cut 6–10 straws or strips of paper in various lengths. Ensure that there are more than one of some lengths. Give strips to another group. They put the strips side by side (shortest to longest) and:
   - find median (middle one) and mode (most frequent/common); and
   - predict where they think mean will be, and work out an informal way to find mean through making lengths the same (cutting bits off the longest and adding to the shortest).
2. Unifix. Repeat the above using coloured Unifix cubes – have sets of 5–7 colours and students make bar graphs by putting colours together. Then they move cubes around for mean (best to prepare Unifix so mean is a whole number).
3. Packets of m&m's or Smarties. Give out packets, students sort into colours and make bar graph of shortest to longest. Students find mode and median – then predict and move m&m's/Smarties to get all the same height bars for mean.

   They can move bars so they are in a line with a marker between bars – this shows that the mean is found by adding and dividing by number of colours (leads to formulas).
4. Students create their own thinkboards to demonstrate the following criteria:
   - The mean of six scores is 30. What is the total of the scores? What could these scores be?
   - If the median and mode are both eight, what could the other statistics be? Make sets of 7, 9 or 11 statistics.
5. Examine these statistics: 6, 8, 5, 7, 42, 8, 5, 4, 5
   - What statistic seems out of place?
   - What is the mean measure of centre in this set?
   - What is the median measure of centre in the set?
   - What is the mode measure of centre in the set?
   - Draw a line graph to illustrate these statistics.
   - Remove the statistic of 42. Recalculate the mean, median and mode. What are the new mean, median and mode? What measure/s of centre has/have been affected? Give reasons for this.

6. What is the disadvantage of representing a set of statistics by just the mean or just the median? How would you overcome this?
7. How does the inclusion of an unusual statistic affect the mean, median and mode? What happens to the mean, median and mode when the unusual statistic is removed?

Connections Relate to lists, frequency tables, graphs, range (lowest score to largest score).

Reflection

Validation Students show real-world contexts in their thinkboard stories where statistics are related to mean, median and mode. Partners validate each other's thinkboards.

Application/ problems Provide problems on measures of centre for students to apply to different real-world contexts independently; e.g. *A librarian conducted a survey on a certain day to find the age group that used the services the Municipal Library provided. The ages of the people entering the library are recorded as follows: 17, 63, 14, 13, 68, 15, 16, 14, 56, 17, 14, 18, 14. The librarian reported to the Municipal Council that teenagers were not using the library because the mean age was well over 15. Is this a fair statement? Give reasons for your opinion*.

Extension **Flexibility**. Students can use a variety of materials, data and processes to justify their calculations of measures of centre.

Reversing. Students are able to move between writing a problem on measures of centre ↔ graphing and calculating measures of centre ↔ using concrete models to show measures of centre or the statistics ↔ writing the formula to solve problems, starting from and moving between any given point.

Generalising. *The **mean** is:* $\frac{sum\ of\ statistics}{number\ of\ statistics}$ *(sum of the statistics ÷ number statistics).*

*The **median** is the middle number in a series of numbers arranged in order from least to greatest. If there is an even number of items in the data set, the median is the average of the two middle values.*

*The **mode** is the most frequently occurring value or statistic in the data set.*

The mean is affected by the inclusion of statistics that are noticeably different from the majority in the set, that is, they are uncharacteristically higher or lower than the rest. The median is not affected by the inclusion of an unusual statistic as its place remains in the centre of the ordered set, lowest to highest. Neither is the mode impacted as this measure of centre relies on the number that is repeated most frequently.

Changing parameters. Discuss the impact on the mean and median if further values are added. Explore the effect on mean values of (a) symmetrical data (low and high numbers matched and most numbers in the centre, or low and high matched but a hole or very little data in the middle); and (b) skewed data (most data in the low end or in the high end). Investigate ways of making the mean and median of a set of figures the same and different.

Use digital technologies to produce statistical measures.

Teacher's notes

- Ensure students have been exposed to different models before attempting to write formulas.
- Students need to be taught the skill of visualising: closing their eyes and seeing pictures in their minds, making mental images; e.g. show a picture of the numbers 6, 7, 8, students look at them, remove the picture, students then close their eyes and see the picture of 6, 7, 8 in their mind; then make a mental picture of a different set of numbers, 3, 4, 5.

- Suggestions in Local Knowledge are only a guide. It is very important that examples in Reality are taken from the local environment that have significance to the local culture and come from the students' experience of their local environment.
- Useful websites for resources: www.rrr.edu.au; https://www.qcaa.qld.edu.au/3035.html
- Explicit teaching that **aligns with students' understanding** is part of every section of the RAMR cycle and has particular emphasis in the Mathematics section. The RAMR cycle is not always linear but may necessitate revisiting the previous stage/s at any given point.

  Reflection on the concept may happen at any stage of the RAMR cycle to reinforce the concept being taught. Validation, Application, and the last two parts of Extension should not be undertaken until students have mastered the mathematical concept as students need the foundation in order to be able to validate, apply, generalise and change parameters.