

Topic	<i>Mathematics Advanced Stage 6 Statistical Analysis</i> MA-S2 Descriptive Statistics and Bivariate Data Analysis S2.1: Data (grouped and ungrouped) and summary statistics
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LESSON 1 OBJECTIVE	Calculate measures of central tendency and spread and investigate their suitability in real-world contexts and use to compare large datasets
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Syllabus Outcomes

- solves problems using appropriate statistical processes MA12-8
- chooses and uses appropriate technology effectively in a range of contexts, models and applies critical thinking to recognise appropriate times for such use MA12-9

Links with Previous Learning

- Calculate mean, median, mode and range for sets of data and interpret these statistics in the context of data (ACMSP171)

Key Language Words / Concepts

- Univariate data, bivariate data
- Central tendency: mean, median, mode
- Measures of spread: range, quartile, minimum, maximum, five-number summary

Summary

The students will revisit the concepts of mean, median and mode, discussing and practicing what they mean, how they are significant and distinct, and how they are computed. They will explore and discuss ranges, quartiles, and the five-number summary describing a single-variable data set.

Sequence of Teaching / Learning Experiences	Time	Resources / Organisation
Introduction Ask the students, given a set of numbers, what they think the middle value is. Present various sequences of numbers to illustrate: 1 2 3 4 5 6 7 1 2 3 10 15 20 2 3 4 4 4 4 4 4 4 50000 Discuss possible different concepts of middle.	3 min	
Mean Ask for definitions, then confirm it as the sum of the numbers in a group, divided by the number of members. In pairs, the students calculate the mean of two groups of numbers: 20 30 40 50 60 70 80 5 10 15 20 100 100 100 Then, to demonstrate the effect of changes to the group on the mean, ask them to recalculate the mean in different (separate) scenarios: - Add five to the smallest number - Add five to every number - Remove the largest number Discuss whether they think the mean signifies what they thought, and if not, what else they might see in it. Ask the students again to work in pairs with a balance. With the arms at equal length, ask them to balance the scales, and then adjust so that one arm is longer, and balance again. The longer arm will bear less weight when the scale balances. This exercise illustrates that the farther from the centre a member is, the greater proportional effect it has on the mean – and that two very different groups can have similar mean values.	7 min	Makeshift balances, or suspended rods, that can be moved along the fulcrum. Weights of various sizes to suspend from each arm.
Median Ask for definitions, then confirm it as the number with equal members greater than and less than itself. Note that, where the group has an even number of elements, the median falls between two members of the group, and is by convention the mean of those two values. (Note that it is only by convention, and any value between the two innermost members would qualify.)	6 min	

In pairs, the students find the median values of the same two groups of numbers. Then repeat the three exercises as above, but then recalculate the median: - Add five to the smallest number - Add five to every number - Remove the largest number The students will then note how the median is affected by the changes relative to the mean, then compare the mean and median for each group. Ask the students what they can infer from the relationship between mean and median.		
Mode Ask for definitions, then confirm it as the most commonly occurring number in the group. Note that a group may not have a distinct mode. Ask the students to find the mode for each of the two number groups, then compare them to the mean and median. Discuss the possible uses, or the scenarios where mode is of interest (populations with limited discrete values). Ask if, in either case, the relationship of the mode to the mean has a significance they can identify.	3 min.	
Minimum, Maximum, and Range Revisiting the two number groups, establish with the students the minimum, maximum values, and the range as the difference between the two. Ask the students what impact the size of the range has on mean or median, or what it could mean in addition to the mean and median. Consider it, in discussion: if one group has a higher average than the other, but also has a much greater range, which group is better?	6 min.	
Quartiles and Five-Number Summary Introduce the quartile, then describe the process for finding Q1 and Q3 using the values already derived for each group, by finding the medians between the minimum and the median, and the median and the maximum. Note, then, that Q1 and Q3 form a sub-range, called the interquartile range or IQR. Ask three students to hold the tubes or cords, one in the centre holding both, and the others at each end. Ask one of the end students to move closer to the middle student, and the other end student to move farther away. This exercise shows how, if the values on either side increase or decrease – but do not cross over the median value – the median is unaffected.	12 min.	Two telescoping tubes, bungee cords, or the like.

Then, ask two more students to join, each grasping the midpoint of one of the tubes or cords. Then, as the outer students move, the new students will also only move if their tube slips through their hands. Now, the students may see how identifying the quartiles, by using the median again, helps to describe the group further. The exercise completes by identifying the Five-Number Summary: Median, Minimum, Maximum, Q1, and Q3.		
Conclusion (Review of new understanding) What might make the mean or median more relevant than the other in certain situations? When might the median become impractical to use?	3 min.	

Assessment of Learning

Engage the students by including them in discussion and involving them in simple but demonstrative activities, especially about not only the definitions and formulae, but what they consider could be the applications and significance of the terms. As each term is introduced, invite them to compare its characteristics with the previous terms, and speculate about what their relative values might signify.