Shooting 3-pointers: Part 2

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| Year level  Strand(s)  Lesson length  CD code | 8  Number  60 mins  [AC9M8N05](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/content-description?subject-identifier=MATMATY8&content-description-code=AC9M8N05&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick), [AC9M8N04](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/content-description?subject-identifier=MATMATY8&content-description-code=AC9M8N04&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick), [AC9M8ST04](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/content-description?subject-identifier=MATMATY8&content-description-code=AC9M8ST04&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick), [AC9M8ST02](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/content-description?subject-identifier=MATMATY8&content-description-code=AC9M8ST02&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick), [AC9M8ST03](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/content-description?subject-identifier=MATMATY8&content-description-code=AC9M8ST03&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick) |
| Lesson summary | Following Shooting 3-pointers: Part 1, in this lesson, students conduct a statistical investigation, collecting and analysing data using percentages, and choosing efficient calculations and strategies. The investigation is communicated visually and verbally to the teacher and peers. Students reflect on feedback and consider revisions for the investigation. |
| Learning intention | Students will:  model a basketball problem and use a mathematical modelling approach to solve the problem  communicate a reasoned solution to an investigative question using supporting mathematical evidence  produce tabular and graphical representations of collected data to effectively communicate the solution and review the model. |
| Success criteria | By the end of this lesson, students can:  use a mathematical modelling approach to solve a real-life sporting question  collect and analyse data and present it in a tabular and infographic presentation  effectively communicate their modelling approach, justify it and review it. |
| Why are we learning about this? | Some professional sports teams use mathematicians to conduct modelling that is designed to uncover winning strategies to give players and teams advantages over other teams. For instance, more NBA players than ever before accurately shoot 3-pointers with every shot. This is a data-driven decision made by the clubs that employ mathematicians to model various outcomes of basketball. |
| Prerequisite student knowledge and language | Students are:  expressing decimals as a percentage  determining the whole, given a percentage  determining the equivalence ratios in their simplest form  calculating averages using sets of data  using a digital spreadsheet  sampling and data collection  approaching real-life problems mathematically  using simple data displays: line graph. |
| Resources | Teacher’s slides (PowerPoint)  Data collection spreadsheet (Excel)  Data collection notes (Word)  Shooting 3-pointers assessment (Word)  A basketball court, cones and basketballs |

Curriculum information

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| Achievement standard | Students use mathematical modelling to solve practical problems involving ratios, percentages and rates in measurement and financial contexts. They solve problems involving the four operations with integers and positive rational numbers.  They conduct statistical investigations and explain the implications of obtaining data through sampling. Students analyse and describe the distribution of data. They compare the variation in distributions of random samples of the same and different size from a given population with respect to shape, measures of central tendency and range. |
| Content description(s) | Students use mathematical modelling to solve practical problems involving rational numbers and percentages, including financial contexts; formulate problems, choosing efficient calculation strategies and using digital tools where appropriate; interpret and communicate solutions in terms of the situation, reviewing the appropriateness of the model. [AC9M8N05](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/content-description?subject-identifier=MATMATY8&content-description-code=AC9M8N05&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick&cdref=Elaboration)  They use the 4 operations with integers and with rational numbers, choosing and using efficient strategies and digital tools where appropriate. [AC9M8N04](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/content-description?subject-identifier=MATMATY8&content-description-code=AC9M8N04&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick)  Students plan and conduct statistical investigations involving samples of a population; use ethical and fair methods to make inferences about the population and report findings, acknowledging uncertainty. [AC9M8ST04](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/content-description?subject-identifier=MATMATY8&content-description-code=AC9M8ST04&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick)  Students analyse and report on the distribution of data from primary and secondary sources using random and non-random sampling techniques to select and study samples. [AC9M8ST02](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/content-description?subject-identifier=MATMATY8&content-description-code=AC9M8ST02&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick)  Students compare variations in distributions and proportions obtained from random samples of the same size drawn from a population and recognise the effect of sample size on this variation. [AC9M8ST03](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/content-description?subject-identifier=MATMATY8&content-description-code=AC9M8ST03&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick) |
| General capabilities  Cross-curriculum priority  Related content | **General capabilities**  Numeracy:   * Proportional thinking (Level 5) * Additive strategies ([Level 10](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/general-capability-snapshot?subject-identifier=MATMATY8&content-description-code=AC9M8N04&general-capability-code=N&element-code=NN&sub-element-index=0&sub-element-code=NNAdS&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick)) * Multiplicative strategies ([Level 10](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/general-capability-snapshot?subject-identifier=MATMATY8&content-description-code=AC9M8N04&general-capability-code=N&element-code=NN&sub-element-index=2&sub-element-code=NNMuS&elaboration-code=AC9M8N04_E2&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick)) * Statistics and probability: Interpreting and representing data ([Level 7](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/general-capability-snapshot?subject-identifier=MATMATY8&content-description-code=AC9M8ST01&general-capability-code=N&element-code=NS&sub-element-index=0&sub-element-code=NSIRD&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick))   Critical thinking:   * Interpret concepts and problems ([Level 5](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/general-capability-snapshot?subject-identifier=MATMATY8&content-description-code=AC9M8ST02&general-capability-code=CCT&element-code=CCTANA&sub-element-index=0&sub-element-code=CCTANAA&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick)) * draw conclusions and provide reasons ([Level 5](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/general-capability-snapshot?subject-identifier=MATMATY8&content-description-code=AC9M8ST02&general-capability-code=CCT&element-code=CCTANA&sub-element-index=1&sub-element-code=CCTANAB&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick)) * Develop questions ([Level 5](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/general-capability-snapshot?subject-identifier=MATMATY8&content-description-code=AC9M8ST04&general-capability-code=CCT&element-code=CCTINQ&sub-element-index=0&sub-element-code=CCTINQA&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick)) * identify, process and evaluate information (Level 5)   Digital literacy:   * Select and operate tools ([Level 5](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/general-capability-snapshot?subject-identifier=MATMATY8&content-description-code=AC9M8N05&general-capability-code=DL&element-code=DLMO&sub-element-index=0&sub-element-code=DLMOC&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick))   Related content  Health and Physical Education: [AC9HP8M02](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/health-and-physical-education/year-8_year-7_year-9/content-description?subject-identifier=HPEHPEY78&content-description-code=AC9HP8M02&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick), [AC9HP8M03](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/health-and-physical-education/year-8_year-7_year-9/content-description?subject-identifier=HPEHPEY78&content-description-code=AC9HP8M03&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick)  Science: [AC9S8I04](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/science/year-8_year-7_year-9/content-description?subject-identifier=SCISCIY8&content-description-code=AC9S8I04&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick) |
| Areas of challenge | Students may:  still be uncomfortable using and understanding percentages and decimals, and how these can be applied in real-world contexts and problems  not connect percentages expressed as decimals from 0 to 1 for 0 to 100%, that is 0.2 = 20/100  not align decimal points correctly when converting decimals to percentages and vice versa  not understand the reason for data being converted to percentages for analysis and statistical displays (visual charts)  not understand that a sample may be too small and not representative of the problem or purpose of the investigation  not understand that two different samples from the same population can show variable results  underestimate bias in samples. |
| Strategies | [Mathematical investigation](https://www.mathematicshub.edu.au/plan-teach-and-assess/teaching/teaching-strategies/mathematics-investigation/)  [Collaborative learning](https://www.mathematicshub.edu.au/plan-teach-and-assess/teaching/teaching-strategies/collaborative-learning/)  [Questioning](https://www.mathematicshub.edu.au/plan-teach-and-assess/teaching/teaching-strategies/questioning/)  [Classroom talks](https://www.mathematicshub.edu.au/plan-teach-and-assess/teaching/teaching-strategies/classroom-talks/)  [Concrete, Representational, Abstract (CRA)](https://www.mathematicshub.edu.au/plan-teach-and-assess/teaching/teaching-strategies/concrete-representational-abstract-cra/) |

Lesson structure

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| Learning hook  30 mins | Note: this lesson begins at the basketball courts. Students should work efficiently as possible, as the remainder of the lesson is finished in the classroom. Students take their laptops to the courts with their spreadsheets ready to record. However, this could also be done on mini whiteboards or in a notebook.  **Data collection at the courts**  Optional: print out the data collection notes for students to take to the courts for reference.  This is a physical activity and is designed to be engaging and fun. Ensure students are kept busy to keep them on task. Two groups can begin on one court, and if you have more courts, have groups run the experiment simultaneously.  Have the students set up their cones when it’s their time to shoot from the six locations. Ensure a data collector is at the ready. Verify each spreadsheet as each group finishes to ensure all required data is collected.  **Iteration**: You could use dynamic software or manipulatives like dice to simulate basketball shots if you cannot physically collect scoring data on a basketball court. Note: though this can introduce probability nicely, it does not allow students to produce authentic data relevant to the learning question itself.   * [Coin flip simulator](https://www.geogebra.org/m/qfymmxnk) – each player uses the simulator or a real coin to flip a yes/no or heads/tails event 10 times for the six locations (total of 60 flips). * [Probabilities: coin flipping](https://www.geogebra.org/m/m6zkdqtw) – this coin flip simulator can be set to be unequally biased. This could nicely simulate a successful or unsuccessful 3-pointer. |
| Explore  20 mins | **Data analysis in the classroom**  The spreadsheet is designed to help display data collection, aid organisation of data and provide an initial graphical presentation of the data. Reinforce the language of statistics and summarise the dialogue on statistics from Shooting 3-pointers: Part 1.  Use slides 1 to 6 of the teacher’s slides to guide students through statistical analysis in steps but use questioning and classroom dialogue to help students reach each step progressively. Teaching notes and suggestions are included with each slide. Again, the slides are animated. The questioning prompts provided can assist with student feedback to allow you to tailor support or extension to some students.  Clarify to students that taking a step-by-step approach when conducting statistical analysis helps to ensure that the analysis answers the original learning question. It will also help develop the important critical thinking and statistical skills required in life to analyse data. (Remind students they will be living in a data-driven age once they finish school.) To scaffold the analysis, the steps required for this activity are shown on each slide.  Note that this lesson helps students to use digital spreadsheets to conduct statistical analysis, but it can be done just as easily by hand, promoting tabling and graphing skills. |
| Summary and reflection  10 mins | Go to slide 7 and use the SWOT analysis to reflect on the statistical model derived and undertaken. There are several ways this can be used and iterations are suggested in the teaching notes in the slide.  Given this is a mathematical investigation, reflect on the success and limitations of the lesson for your school and class, so that you may run it successfully again the following year. |
| Assessment | The following formative assessment task suggested to assess how each student understood the investigation.  Refer to the original Shooting 3-pointers assessment given to students last lesson (or give the handout now). Explain the individual assessment that finishes this investigation. Students are required to use their statistical ‘evidence’ to make a recommendation to a fictional basketball coach on adopting or not adopting (depending on results) the 3-pointer strategy. (Slide 8 can be used here.) |