Shooting 3-pointers: Part 1

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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 | This lesson, split into two parts, gives students the opportunity to participate in a real-life problem both in and out of the classroom. Students are guided through the process of formulating a problem that can be solved using a mathematical modelling approach. A professional sporting context allows students to engage in a common basketball scoring move: shooting 3-pointers. In Shooting 3-pointers: Part 2, students conduct a statistical investigation, collecting and analysing data using percentages and equivalent decimals, and choosing efficient calculations and strategies. |
| Learning intention | We will model a basketball problem and use a mathematical modelling approach to solve the problem.  We will communicate a reasoned solution to an investigative question using supporting mathematical evidence.  We will 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 template (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) | 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)  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)  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)  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)  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 ([P5](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=N&element-code=NN&sub-element-index=0&sub-element-code=NNPrT&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick)) * Additive strategies ([P10](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 ([P10](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 ([P7](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 ([P5](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 ([P5](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 ([P5](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 ([P5](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=CCTINQ&sub-element-index=0&sub-element-code=CCTINQB&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick))   Digital literacy:   * Select and operate tools ([P5](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  25 mins | **Introduction**  Display the teacher’s slides and the teaching notes that complement the lesson. The slides could also be printed for students if needed.  Introduce the activity to the class and provide prompting questions in the teaching notes, designed to immerse students in the world of professional basketball; that is, types of basketball scoring shots, what shots students like to practise, and considering the types and number of shots professional basketballers take. Ask students the following investigative question: why do basketball players shoot so many 3-pointers? (slides 1 and 2)  Inform students that professional sports team (like in the NBA) employ mathematicians. They use mathematical modelling to analyse data (game stats) to inform teams on how to win games, for example, what players need to score to win games.  Tip: hook students in by showing short videos of professional players scoring 3-pointers in NBA/WNBA.  **Learning intention/success criteria**  Discuss the learning intentions and success criteria for this lesson sequence. Inform students that they are learning how to think mathematically when constructing and testing a problem that exists in the real world. Explain that the activity is designed to guide students through the formulation of a mathematical model to investigate a real-life question, to collect and use data, to analyse the data, to communicate the results back to the class, and to suggest revisions to the model when considering feedback (slide 3).  **Skills check**  This lesson gives teachers the opportunity to guide students through the mathematical modelling process. The problem and investigation into the problem is predetermined in this activity; however, students are guided along the path step by step. Teachers are encouraged to use classroom dialogue and questioning to have students use critical thinking skills to uncover the reasons for the approach taken. Use the ‘wh’ and how’ questions to help students suggest the next step and answer why they are taking this step, whether it be construction of the problem or performing a calculation.  Slides 4 and 5 are designed to test prerequisite knowledge, specifically percentages, decimals and proportional reasoning. These are skills taught in Year 7; however, they are important arithmetic skills to consolidate. Ensure you can connect the arithmetic to the investigation, so that students can access deeper mathematical thinking skills.  Go through the slide questions as a class. Students are expected to provide full sentences within the basketball context in their notes. An extension question is also provided. Answers are provided in the teaching notes in the teacher’s slides, including a fist-to-5 temperature test to identify those students requiring support or extension. |
| Explore  30 mins | **Data collection**  Circulate the Mathematical modelling assessment and Data collection notes handouts to students (slide 6). Inform the class they will be working in groups. It is suggested to predetermine groups for this task, given there is a physical and sporting aspect to it, but also to have students collaborate and support their peers who are at different levels of mathematical achievement.  Introduce the set-up to the task:  ‘As a budding young mathematician and fan, you decide to send a basketball coach an email with a suggested winning strategy. You’ve noticed recently that the team doesn’t shoot many 3-pointers, even though most of the players shoot two-pointers with a high degree of accuracy.  Write a convincing email to the coach to persuade him that shooting 3-pointers is a good idea. The coach is notoriously sceptical and can only be swayed by strong evidence. Therefore, your email must include data, calculations and graphs, and relevant analysis of them. To submit, send this email to your teacher.’  Explain that this task is an investigation and one in which they will (with guidance) break down the investigative question to formulate a mathematical model to test the conjecture proposed. Students will produce and collect their own data, present the data in an organised way, correctly use calculations (involving percentages), plot data effectively, provide written analysis that is relevant and accurate, communicate results as a group in a logical manner, support logic with mathematical evidence, consider feedback, and compose a persuasive email that identifies both the strengths and weaknesses of the model used.  **To begin the task**  It’s important to use a questioning technique to have students create their own ideas for collecting and analysing data. While the steps suggested in the slides are to progress the investigation and are designed to scaffold all abilities, feel free to edit the slide show or investigation to suit the way students drive the discussion. Your class may decide to run the investigation slightly differently according to their own great ideas. Otherwise, use the slides as a guide or follow them explicitly.  Refer to slide 7 and the teaching notes. The slides are animated so that the teacher has time to prompt the class before the steps are explicitly given on the slide by clicking the mouse.   * Students will produce scoring data based on six locations on a basketball court where players can take legal shots. If you can, use the language of basketball as shown in the diagram for those students unfamiliar with the game, to increase engagement.   Talk about data: question students on sampling and the type of data collection that best suits this task (random, non-random, qualitative, quantitative); discuss the implications and advantages of different ways of collecting data for this scenario; discuss how a team should organise the data so that it is collected meaningfully (should they use a table, spreadsheet, tally); could they use digital tech to collect data?  Allow students to confer with their groups and decide exactly on their chosen six locations, with each member of the team having 10 attempts to score shots from each of the six locations.  Introduce the excel spreadsheet (slide 8) and show students how they will collect data. Demonstrate where they will enter data for their team members and reiterate the language of maths: number of shots will be recorded as the equivalent decimal (since they are taking ten shots). Ensure students understand this point.  Share the spreadsheet with each group, and have the group set up their spreadsheets, typing in names of the group members in the relevant row. Ensure students save the spreadsheet to their device to quickly access it the following lesson.  An iteration on data collection is given in Shooting 3-pointers: Part 2.  **End of Part 1**  This is a natural end to Part 1 of the investigation. Shooting 3-pointers: Part 2 requires set up, time on the court and time for analysis. Feel free to iterate where you end Part 1 to suit your timetable and maths lesson sequence. |
| Summary and reflection  5 mins | Summarise the task to ensure students are free to ask questions using this time.  Prepare to set up the iteration of the collection of data ready to begin when the bell goes. |
| Assessment | The following opportunity for continual assessment for the halfway point of this investigation is suggested below.  Have students reflect on percentages and decimals. Use the Summary and reflection time to consolidate further explanation and learning, to be able to continue with Shooting 3-pointers: Part 2. |