Capital Airways: Part 1

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| Year level  Strand(s)  Lesson length  CD code | Year 10  Space, Algebra  60 mins  [AC9M10SP02](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-10/content-description?subject-identifier=MATMATY10&content-description-code=AC9M10SP02&load-extra-subject=MATMATY10&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&achievement-standard=df3909a9-764f-470a-a778-1a6cb1be8983&side-by-side=1&strands-start-index=3&subjects-start-index=0&view=quick), [AC9M10A04](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-10/content-description?subject-identifier=MATMATY10&content-description-code=AC9M10A04&load-extra-subject=MATMATY10&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&achievement-standard=df3909a9-764f-470a-a778-1a6cb1be8983&side-by-side=1&strands-start-index=1&subjects-start-index=0&view=quick) |
| Lesson summary | This is the first of two lessons in the Capital Airways series. Students are introduced to the concept of a network through an airline route map. The task extends into a detailed mathematical modelling activity with students exploring in teams how to re-design the network map to improve the airline’s profitability. |
| Learning intention | * We are learning the key language associated with networks. * We are learning to understand how to create and interpret network diagrams. * We will learn the complexities in building mathematical models and begin to tackle a modelling problem. |
| Success criteria | By the end of this lesson, students can:  name and describe the key features of a network diagram  interpret a network diagram to answer practical problems  amend or create a network diagram to meet specific criteria  use or build a mathematical model in a spreadsheet to optimise financial outcomes. |
| Why are we learning about this? | Creating, interpreting and manipulating network diagrams is a skill set applicable in logistics, computer science and social sciences. Delving into the complexities of mathematical modelling, equips us to use or build a spreadsheet model to optimise financial outcomes. This provides practical problem-solving tools for real-world scenarios with many business applications. |
| Prerequisite student knowledge and language | Prior to this lesson, it is assumed that students have some knowledge of:  basic spreadsheet functionality including cell referencing and performing calculations using symbols such as = \* and /  personal experience or understanding of the airline business, although no specialist knowledge is assumed  language important for this lesson including node, vertex, edge, connected network, degree. |
| **Resources** | Teacher’s slides (PowerPoint)  Activity 1 (Word)  Activity 1 answers (Word)  Capital Airways [quiz](https://take.quiz-maker.com/QBNUR1KSA)  Laptops or iPads with spreadsheet package available |

Curriculum information

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| Achievement standard | Students interpret networks used to represent practical situations and describe connectedness and use mathematical modelling to solve problems in financial and other applied situations, applying linear functions as appropriate. |
| Content description(s) | Students interpret networks and network diagrams used to represent relationships in practical situations and describe connectedness. [AC9M10SP02](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-10/content-description?subject-identifier=MATMATY10&content-description-code=AC9M10SP02&load-extra-subject=MATMATY10&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&achievement-standard=df3909a9-764f-470a-a778-1a6cb1be8983&side-by-side=1&strands-start-index=3&subjects-start-index=0&view=quick)  Students use mathematical modelling to solve applied problems involving growth and decay, including financial contexts; formulate problems, choosing to apply linear, quadratic or exponential models; interpret solutions in terms of the situation; evaluate and modify models as necessary and report assumptions, methods and findings. [AC9M10A04](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-10/content-description?subject-identifier=MATMATY10&content-description-code=AC9M10A04&load-extra-subject=MATMATY10&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&achievement-standard=df3909a9-764f-470a-a778-1a6cb1be8983&side-by-side=1&strands-start-index=1&subjects-start-index=0&view=quick) |
| General capabilities  Cross-curriculum priority | Numeracy:   * Number patterns and algebraic thinking ([Level 9](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-10/general-capability-snapshot?subject-identifier=MATMATY10&content-description-code=AC9M10A04&general-capability-code=N&element-code=NN&sub-element-index=0&sub-element-code=NNNPA&load-extra-subject=MATMATY10&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&achievement-standard=df3909a9-764f-470a-a778-1a6cb1be8983&side-by-side=1&strands-start-index=1&subjects-start-index=0&view=quick))   Critical and creative thinking:  Consider alternatives ([Level 6](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-10/general-capability-snapshot?subject-identifier=MATMATY10&content-description-code=AC9M10A04&general-capability-code=CCT&element-code=CCTGEN&sub-element-index=0&sub-element-code=CCTGENB&load-extra-subject=MATMATY10&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&achievement-standard=df3909a9-764f-470a-a778-1a6cb1be8983&side-by-side=1&strands-start-index=1&subjects-start-index=0&view=quick))  Identify, process and evaluate information ([Level 6](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-10/general-capability-snapshot?subject-identifier=MATMATY10&content-description-code=AC9M10A04&general-capability-code=CCT&element-code=CCTINQ&sub-element-index=0&sub-element-code=CCTINQB&load-extra-subject=MATMATY10&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&achievement-standard=df3909a9-764f-470a-a778-1a6cb1be8983&side-by-side=1&strands-start-index=1&subjects-start-index=0&view=quick))  Interpret concepts and problems ([Level 6](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-10/general-capability-snapshot?subject-identifier=MATMATY10&content-description-code=AC9M10A04&general-capability-code=CCT&element-code=CCTANA&sub-element-index=0&sub-element-code=CCTANAA&load-extra-subject=MATMATY10&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&achievement-standard=df3909a9-764f-470a-a778-1a6cb1be8983&side-by-side=1&strands-start-index=1&subjects-start-index=0&view=quick))  Draw conclusions and provide reasons ([Level 6](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-10/general-capability-snapshot?subject-identifier=MATMATY10&content-description-code=AC9M10A04&general-capability-code=CCT&element-code=CCTANA&sub-element-index=1&sub-element-code=CCTANAB&load-extra-subject=MATMATY10&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&achievement-standard=df3909a9-764f-470a-a778-1a6cb1be8983&side-by-side=1&strands-start-index=1&subjects-start-index=0&view=quick)) |
| Areas of challenge | Some students may have limited knowledge about the airline industry and struggle to identify potential model inputs and variables – use slide 5 from the teacher’s slides as a stimulus with questioning, for example: ‘Why do you think it would be useful to know what routes competitors fly and what they charge?’  Students may believe that network maps must accurately reflect the position of people, places and things – refer to local examples such as train and bus maps or circuit diagrams that are not drawn to scale and discuss why this is the case.  Some students have gaps in spreadsheet skills or knowledge – explicitly demonstrate and explain the key features and operation of spreadsheets. Use the provided Excel model and encourage students to interrogate formulae in cells to understand how the calculations have been derived. For students creating their own models, encourage use of online help videos. |
| Strategies | [Collaborative learning](https://www.mathematicshub.edu.au/plan-teach-and-assess/teaching/teaching-strategies/collaborative-learning/)  [Mathematics investigation](https://www.mathematicshub.edu.au/plan-teach-and-assess/teaching/teaching-strategies/mathematics-investigation/)  [Questioning](https://www.mathematicshub.edu.au/plan-teach-and-assess/teaching/teaching-strategies/questioning/) |

Lesson structure

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| Learning hook  15 mins | In this lesson, students work as a team to explore networks and different modelling assumptions, drawing upon their own experiences and insights. This is best done over two lessons: the Introduction and Activity 1 in Part 1, and Activity 2 in Part 2. Download the teacher’s slides and the accompanying student resources to use alongside this lesson.  **Learning hook**   * (Slide 2) Ask students to identify the diagram that doesn’t belong and to justify their answers. * Review students’ responses as a class. If students have already been introduced to networks encourage them to use the formal language of ‘vertex’, ‘node’, ‘edge’ and ‘connected network’.   Possible responses include:  A: because there are only four lines (edges) while the others have five; or because it doesn’t have an enclosed shape, while the others do; or because it is the only diagram where it is not possible to travel along all the edges without repeating an edge  B: because the dots (vertices) are not arranged in a square/rectangular shape, while the others are  C: because one of the vertices is not connected to the others  D: because there are only four vertices while the others have five; or because the edges do not directly connect the vertices with some edges meeting other edges (hence this is not a simplified network diagram).  **Introduction**  (Slides 3 and 4) If this is the class’s first lesson exploring the concept of networks, view the slides and use the [questioning](https://www.mathematicshub.edu.au/plan-teach-and-assess/teaching/teaching-strategies/questioning/) strategy to get students thinking deeply about the content. For instance:   * ‘What could these diagrams represent?’ Elicit the concept of **network diagrams** being a simplified visual way of representing connections between people, places and objects. Also refer to the slide examples: a circuit diagram, train map, basic IT network and social network. * Question students about scale and accuracy, ‘Does the train map exactly follow the train lines? If not, why not?’ Elicit the understanding that network diagrams do not need to be drawn perfectly to scale or show the exact position of items, but rather to just show the relationships.   Go to the animated slide 4 to introduce the metalanguage of networks, defining the terms **vertex**/**node**, **edge** and **degree**. |
| Explore  30 mins | Note: Print (or provide a digital copy) Activity 1 and distribute to the class.  **Interpreting network diagrams**   * (Slide 5) Introduce Activity 1: Exploring the Capital Airways network. Explain the scenario:   ‘You are the new CEO (Chief Executive Officer) of Capital Airways, a small airline whose proud boast is: ‘We can fly you to every Australian capital.’ You want to get to know the airline and understand where the company flies and so you have been given the network (route) map for Capital Airways.’   * The task is to use the network map to answer the questions in the worksheet. Students work in pairs or individually. * Monitor students’ progress and review answers as a class.   **Differentiation (extend)**: question 14 provides an (optional) opportunity to explore the concept of Eulerian walks. |
| Summary and reflection  15 mins | (Slide 6) Ask students to copy the diagram and annotate it using the labels and defining key terms.  As a class, review the summary by dragging and dropping labels in the PowerPoint slide.  Ensure to reserve 5 minutes for the assessment quiz. |
| Assessment | The following formative assessment opportunity is described below.  Provide the link for the [interactive quiz](https://take.quiz-maker.com/QBNUR1KSA) to the class and have students complete the questions. Alternatively, use slides 7–9 where students answer the same questions in their exercise books for your review and feedback. |