**Stage 2 General Mathematics**

**Assessment Type 2: Mathematical Investigation**

**Topic 2: Modelling with Dominance Matrices**

**Introduction**

Dominance matrices can be useful in round robin sporting competitions in order to rank teams and predict future outcomes based on current season performances about which team might win a competition.

**Your unique information**

You will choose a sport or competition played in a ‘round robin’ format where results can be easily obtained for *a completed season* so the final ranking of the teams is known. (Note: the word ‘round’ can be used in many senses in sports, however in this task the term ‘round’ is taken to mean that each team has played every other team once.)

Some suggestions of sports leagues you could consider include: SANFL, NBA, Australian Netball League or A-Leage soccer. Note: Competitions in which there are large numbers of teams will mean very large matrices. If you choose to investigate a larger competition, you should select a subset of the teams to use – e.g. From all of the AFL competition you could use the results from eight of the teams.

**Key information about predictions RC5:**

Students are required to make and test at least one two predictions based on the mathematics that they are using to consider scenarios.

In the process of forming and testing predictions, students will need to:

* State the prediction
* Test the prediction mathematically
* Discuss the outcome of testing the prediction.

To reach the A grade band for RC5, students need to form and test more than one appropriate prediction.

**Part A**

Consider the sport you have chosen to investigate. Use it to demonstrate your knowledge with respect to dominance matrices.

Concepts to include:

* Elements of a network diagram e.g. lines, arrows
* Network diagram for your scenario
* Elements of a dominance matrix e.g. size, key features, how you represented a win, loss (and draws if necessary)
* Dominance matrix D
* Use D to rank the teams
* Compare the ranking from D to the ranking at the end of the season
* Discuss the reasonableness and limitations of using the dominance matrix alone to make predictions

**Part B**

Consider the use of a supremacy matrix to ranking the teams. Include a prediction of what will happen to both the order that the teams are ranked as well as if it will be a better predictor of the season outcome before you begin each new supremacy matrix. Give a complete interpretation of the impact of each change, including changes to the overall ranking and if it gave a better prediction of the season results.

Concepts to include:

* Calculate and explain the meaning of the second order dominance matrix $D^{2}$
* Calculate a supremacy Matrix S (where $S = D+\frac{1}{2}D^{2}$)
* Use the supremacy matrix to rank teams
* Calculate and use the third order dominance matrix in the supremacy matrix to rank the teams
* Investigate if your rankings help predict the outcome of future games the teams played each other (Note: You could create some further predictions from your rankings about who you think would win when they play each other another time)

**Part C**

Investigate complex changes to your dominance matrix D and/or your supremacy matrix S for your given sporting scenario. Remember to create predictions around if the new model will predict the end of the season results better. Changes can include, *but not limited to*:

* Different weightings in the supremacy model
* Changing Dominance Matrix D to incorporate wining margins
* Including more teams in your Dominance matrix
* Including a second round of teams playing each other in your Dominance matrix

Discuss how could team rankings be used in real life. Be sure to comment on any limitations of the models in this investigation that could influence your results.

**Report Format**

The report may take a variety of forms, but would usually include the following:

* an outline of the problem and context
* the method required to find a solution, in terms of the mathematical model or strategy used
* the application of the mathematical model or strategy, including:
	+ relevant data and/or information
	+ mathematical calculations and results using appropriate representations
	+ discussion and interpretation of results, including consideration of the reasonableness and limitations of the results
* the results and conclusions in the context of the problem.

A bibliography and appendices, as appropriate, may be used. The format of an investigation report may be written or multimodal.

**Performance Standards for Stage 2 General Mathematics**

| - | **Concepts and Techniques** | **Reasoning and Communication** |
| --- | --- | --- |
| **A** | Comprehensive knowledge and understanding of concepts and relationships.Highly effective selection and application of mathematical techniques and algorithms to find efficient and accurate solutions to routine and complex problems in a variety of contexts.Successful development and application of mathematical models to find concise and accurate solutions.Appropriate and effective use of electronic technology to find accurate solutions to routine and complex problems. | Comprehensive interpretation of mathematical results in the context of the problem.Drawing logical conclusions from mathematical results, with a comprehensive understanding of their reasonableness and limitations.Proficient and accurate use of appropriate mathematical notation, representations, and terminology.Highly effective communication of mathematical ideas and reasoning to develop logical and concise arguments.Formation and testing of appropriate predictions, using sound mathematical evidence. |
| **B** | Some depth of knowledge and understanding of concepts and relationships.Mostly effective selection and application of mathematical techniques and algorithms to find mostly accurate solutions to routine and some complex problems in a variety of contexts.Attempted development and successful application of mathematical models to find mostly accurate solutions.Mostly appropriate and effective use of electronic technology to find mostly accurate solutions to routine and some complex problems. | Mostly appropriate interpretation of mathematical results in the context of the problem.Drawing mostly logical conclusions from mathematical results, with some depth of understanding of their reasonableness and limitations.Mostly accurate use of appropriate mathematical notation, representations, and terminology.Mostly effective communication of mathematical ideas and reasoning to develop mostly logical arguments.Formation and testing of mostly appropriate predictions, using some mathematical evidence. |
| **C** | Generally competent knowledge and understanding of concepts and relationships.Generally effective selection and application of mathematical techniques and algorithms to find mostly accurate solutions to routine problems in different contexts.Application of mathematical models to find generally accurate solutions.Generally appropriate and effective use of electronic technology to find mostly accurate solutions to routine problems. | Generally appropriate interpretation of mathematical results in the context of the problem.Drawing some logical conclusions from mathematical results, with some understanding of their reasonableness and limitations.Generally appropriate use of mathematical notation, representations, and terminology, with reasonable accuracy.Generally effective communication of mathematical ideas and reasoning to develop some logical arguments.Formation of an appropriate prediction and some attempt to test it using mathematical evidence. |
| **D** | Basic knowledge and some understanding of concepts and relationships.Some selection and application of mathematical techniques and algorithms to find some accurate solutions to routine problems in context.Some application of mathematical models to find some accurate or partially accurate solutions.Some appropriate use of electronic technology to find some accurate solutions to routine problems. | Some interpretation of mathematical results.Drawing some conclusions from mathematical results, with some awareness of their reasonableness.Some appropriate use of mathematical notation, representations, and terminology, with some accuracy.Some communication of mathematical ideas, with attempted reasoning and/or arguments.Attempted formation of a prediction with limited attempt to test it using mathematical evidence. |
| **E** | Limited knowledge or understanding of concepts and relationships.Attempted selection and limited application of mathematical techniques or algorithms, with limited accuracy in solving routine problems.Attempted application of mathematical models, with limited accuracy.Attempted use of electronic technology, with limited accuracy in solving routine problems. | Limited interpretation of mathematical results.Limited understanding of the meaning of mathematical results, their reasonableness or limitations.Limited use of appropriate mathematical notation, representations, or terminology, with limited accuracy.Attempted communication of mathematical ideas, with limited reasoning.Limited attempt to form or test a prediction. |