**Stage 2 General Mathematics**

**Assessment Type 2: Mathematical Investigation**

**The Hungarian Algorithm**

**The Task**

A school swimming coach has asked for volunteers to swim the 4 x 50m medley relay at the interschool swim meet. Altogether 9 students have put their names down (R - Z). The coach must decide how to form the best team and whether to make a second team for this race.

**Part 1:**

The range of average times for students to swim 50 metres of each of the strokes is:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Freestyle | Breaststroke | Backstroke | Butterfly |
| Avg time (secs) | 28 - 38 | 40 - 50 | 35 - 45 | 32 - 42 |

Construct a spreadsheet which will randomly assign times for each of the nine students in each leg of the relay using these guidelines. Times should be calculated in whole seconds.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | R | S | T | U | V | W | X | Y | Z |
| Freestyle |  |  |  |  |  |  |  |  |  |
| Breaststroke |  |  |  |  |  |  |  |  |  |
| Backstroke |  |  |  |  |  |  |  |  |  |
| Butterfly |  |  |  |  |  |  |  |  |  |

**Part 2:**

The coach decides to put the first four students who put their names down (R – U) in the relay team (A-team).

Make a prediction, with some discussion of your reasoning, of how you think these students should be assigned to the four different sections of the race.

Determine, using the Hungarian Algorithm, which of these students should swim each stroke. Compare your answer with the prediction you made.

The coach wants to create a second medley team (B-team) from the remaining five students (V – Z). Determine, using the Hungarian Algorithm, who should be in this team and which stroke each one should swim. Which student misses out on a place?

**\*\*NOTE: If either of the problems above can be done simply ‘by inspection’ (i.e. does not require the use of the Hungarian Algorithm for its solution) you should recalculate your spreadsheet until this is no longer so.**

**Discuss and compare** the resulting relay times for the two teams.

**Part 3:**

Can the coach create a better A-team than the one found in Part 2 if (s)he selects the team from all nine students? Investigate this question and discuss the implications for the two teams and their total relay times.

Students are required to make and test at least one further prediction based on the mathematics that they are using to consider further 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 4:**

The ninth student who did not make either of the teams in Part 3 has been kept as a reserve. Suppose one of the A-team is injured on the day of the race and cannot swim (your choice of who this is). Investigate the choices the coach has for assignment of the swimmers and the effects of these choices on the expected race times of the two teams. (*The coach could simply substitute the reserve for the injured swimmer, (s)he could reassign the swimmers within the A-team using the reserve or (s)he could reassign both teams using the eight swimmers available*).

**The Report**

Write a report in the appropriate format which introduces the task, shows your mathematical investigation and your discussion of the results and conclusions drawn. Include a discussion of underlying assumptions made and the possible limitations imposed by them on the solutions.

**This investigation report should be a maximum of 12 single-sided A4 pages if written, or the equivalent in multimodal form.**

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. |