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NCEA LEVEL **1** Standards ✕

<p>Mathematics and Statistics 1.1</p> <p>Explore data using a statistical enquiry process</p> <hr/> <p>91944 ↻ Internal 5 Credits</p>	<p>Mathematics and Statistics 1.2</p> <p>Use mathematical methods to explore problems that relate to life in Aotearoa New Zealand or the Pacific</p> <hr/> <p>91945 ↻ Internal 5 Credits</p>	<p>Mathematics and Statistics 1.3</p> <p>Interpret and apply mathematical and statistical information in context</p> <hr/> <p>91946 ↻ External 5 Credits</p>	<p>Mathematics and Statistics 1.4</p> <p>Demonstrate mathematical reasoning</p> <hr/> <p>91947 ↻ External 5 Credits</p>
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*The New NCEA Level 1 Standards operating in 2024.*

# Jim Hogan's Mathematics and Statistics Newsletter Term 4 2023

## Mathematical Methods at NCEA Level 1



**Ānō me he whare pūngāwerewere.  
Behold, it is like the web of a spider**

### **Greetings Everyone.**

Term 4 2023 already! Time goes so fast when you are having fun. This news is a little shorter because of the elections and the RWC. It is all about time. A reminder that previous newsletters are on my website and the last few are still very relevant to current NCEA developments.

I hope you all managed your workload well during 2023 and have the final run to the finish all sorted. There will be surprises as manage your workload and leave a gap in each day.

all sorted. There will be surprises so manage your workload and leave a gap in each day. It will fill!

Next year is something you probably do not need reminding about but like pūngāwerewere, be prepared. There are a lot of electioneering statements concerning education and NCEA and some strange moves away from the now connected math strands from schools who should know better. At last we have a refreshed approach, sensible standards and the opportunity to create an exciting Year 11 programme. Be prepared for 2024 and make sure all programmes are turn-key finished before the day you lock your office door for this year.

The new standards at NCEA L1 will be at the forefront of PLD and Teaching and Learning programme development for 2024. This includes the new way of assessing Numeracy (and Literacy Reading and Writing) all of which must be a school wide responsibility. I have a few contracts with this theme to finish in 2024 but I do have capacity to help a few more schools if asked.

### **A Teaching and Learning Tip**

Everyone is a teacher of literacy and numeracy. The third criteria for the new Numeracy Standard requires an **EXPLANATION**. The first involves **formulating** and **explaining** as well. Math teachers must practice explanation. Model **explanation** in class and rework to refine students attempts at explanation. Just start with past papers and student suggestions and have a "class to group to individual" mastery approach. It has to be done and will add a bit of variation to classroom normality. You will know you are successful when you hear and read clear, concise, and astute explanation. A little every day will work.

### **Te Mātaiaho**

Your understanding of [Te Mātaiaho](#) is very important so take a long while to get the collective departmental brains around this informing document. It is now 2024 just in case you had noticed. Almost a quarter of a century on from the last century! Many things have changed and been discovered. A new approach was needed and thanks to the Ministry, we have one. Embrace the obvious inclusion of Māori words, knowledge and approaches. Te Ao Maori is very real to an increasing portion of New Zealand and I think we can all learn from the tikanga or practices. Inclusion is what is needed.

We now have calculators, computers and cellphones. The world is connected in fractions of a second and the Eighth Wonder of the World, The WWW Internet is growing even faster. *[Eric Schmidt, the CEO of Google, the world's largest index of the Internet, estimated the size at roughly 5 million terabytes of data. That's over 5 billion gigabytes of data (almost a gig per person on Earth- Jim), or 5 trillion megabytes. AUF 2023].* There now 8 billion people on the planet and the planet is showing signs of human intervention. The weather and sea level being two of these signs. We need now more than ever a literate and numerate global population. We have a good start here in NZ but there is a lot to maintain and develop. Sifting truth and lies has become vital. We need to be educated and critical. Be a sceptic!

Te Mātaiaho describes the "what to learn" in conceptual mathematics and also the competencies needed for the 21st Century. Perseverance in problem solving, creativity and critical thinking and communication or as I like to say, **Speak, Read, Write, Listen and Do**. An educated, math and science savvy population is what our leaders have prioritised and I think that is a worthy goal. Embrace the wisdom!

### **What are we doing Mathematically?**

The web of pūngāwerewere is a metaphor to the interconnected strands, concepts and skills in mathematics. It could be three dimensional, or many dimensional, but the spider uses a 2d net. The siloed strands, and ideas within strands, will be a thing of the past once the new standards are embedded from NCEA 1 all the way to NCEA 3. I hone the

universities are also on board and make the big changes needed. Universities are dreadfully behind in modern teaching, learning and assessment practices and their programmes cling to the past structures and content which the academics know and cherish. The focus should be on students.

Reawakening the strands and connections has restored the integrity of mathematics. We have to rebuild our teaching practices and assessments methods to reflect these changes. AND YES; this means spending time on schemes. It is also a very good opportunity to sort resources and empower the department. Take the lead, design a way forward, begin the journey. Enjoy the journey too. In my experience being prepared this year for next year solved the workload issue. There is no time for deep dialogue and scheme design once the new teaching year begins. Kid yourself not... you will be otherwise occupied.

I am remembering that the Burgundy Bible, the Maths Curriculum from 1987, contains many valuable connected resources. It will be in your resource room. Burgundy because of the colour! It is not the current curriculum but you will find everything we currently teach as well as a few extras like Matrices. Read pages 11 and 12. There are omissions like "Bootstrapping" as well. The complete book is in this file.

**Burgundy Bible.pdf**



A quote from Page 11 on Problem Solving

"Students learn mathematical thinking most effectively through applying concepts and skills in interesting and realistic contexts which are personally meaningful to them. Thus, mathematics is best taught by helping students to solve problems drawn from their own experience."

This all sounds very like the new standards.

## Mathematical Methods

A major understanding for teachers to grasp in the new achievement standards and the numeracy standard is what are referred to as "**Mathematical Methods**". What are they? I have titled this newsletter "Mathematical Methods at NCEA Level 1" for that reason and to try and gain your attention and focus.

Mathematical Methods are specific ideas, small and big, that have been developed over time and by brilliant minds to explore and solve problems. Mathematics is actually "thinking" and the methods manifest this thinking and describe skills and knowledge that is learnt when studying Mathematics and Statistics. Mathematical Methods include approaches to problem solving.

An example is **Pythagorus' Theorem**. There actually there are three **methods** involved here. At Y10 and Y11 finding either side length or hypotenuse is three methods. We could add finding the angle and get another three. We could add the non-right angled situations but that is not at NZC L6. A related idea the area of the triangle as  $\frac{1}{2}ab\text{Sine}C$  is another method.

**MATH DEPT TEACHER TASK - With another teacher choose a strand and list 50 methods buried within. Then allocate an NZC teaching level to each. Present and share.**

**For Example, Algebra, Factorisation of Quadratics, NZC Level 5, Year 10, Year 11, General Method of Factorising a Quadratic, Year 12.**

Specific methods are listed in each standard and in the NZC. These are the key to gaining NCEA L1 when evidence of a variety of methods applied over at least three strands is required. I described all of those and the implication in my Term 3 2023 Newsletter. Find that news on my website, home page - middle - bottom.

The [Assessment Description](#) on NCEA Education assumes we all know what these methods are and can recognise and explain how they are used at NZC L6.

### **Is this an OK assumption for your department?**

For specialist Math teachers only working in one department this is probably a correct assumption. For the teachers roped into a mathematics class from PE, Geography or Science this is probably not a correct assumption. Here is the description of that [Understand, Know and Do at NZC L6](#)

We all have at least three “hats” to wear as teachers. We have a **Teaching Hat**, an **Assessing Hat** and a permanent **MathED PLD Hat or Self Development Hat**. De Bono might be able to tell you what colour these hats are. Other hats teachers wear include Sports, Dean, HOD, and the myriad of other responsibilities that schools create to make the school tick and keep teachers busy. We are all makers of our own destiny!

### **The Teaching Hat**

I talked at length about the **Teaching Hat** in my Term 1,2 and 3 news letters all posted on my [website](#). To summarise, I think we all know what Year 11 Mathematics looks like and now that the strands have been reconnected blessed be connected lessons that develop a structure. The content of your current Year 11 Scheme is not different from the content of the new 2024 Year 11 Scheme. Fractions still have to taught before decimals and percentage. Students still have to be multiplicative before entering the proportional world. "Hands on" and visual models need to precede theoretical and more abstract approaches. Home work and practice will still be required. Algebra becomes more than patterns and nth term.



### **The Assessing Hat**

I have visions of the Sorting Hat in Harry Potter here. Just my sense of humour! I like watching that hat at work. HMMMMMM!

**Bold RED Italic** below are quotes from the **Assessment Description** page referenced above.

***Assessors cannot give direct instructions on what to do, such as to use Pythagoras' theorem to find a specific length within an identified problem.***

Be careful in assessing and assessments to **ensure that it is the student who selects** the method to solve the problem. Violate this and you will invalidate the assessment. Start again!

Teachers have a strong urge to have their students succeed. I call this teacher LUST. Every teacher has to be brave, *kia kaha*, not to remove this essential aspect of problem solving. **DO NOT TELL**. Build confidence in teaching and Learning programmes about 'selecting' and relying on your own decisions. Mistakes are good. Mistakes we learn from.

I met a past student of mine who I can still remember working on a problem in the Physics Lab D7 at Tauhara. I meandered past and she asked "Is this right Sir?" I responded with "Believe in your own thinking".

I met Gemma 6 or 7 years later when visiting a school as Maths Advisor and she strolled confidently up to me in the staffroom and gave me a big hug just before reminding me who she was. "I have always wanted to meet you again and say thank you for telling me to believe in my own thinking. It was in Physics class at the end of the year while we were revising. You did not tell me the answer or say I was right. For me that has been a personal driver ever since. It drove me to succeed at University gaining a Chemistry Degree and now teaching science. Thank you. I tell students the same thing." We talked for a while and she shared her journey with me. I really enjoy meeting my ex students and asking them questions.

This story is an example of a quote I often make. **"You might think you know what you are teaching but you are wrong. You might think you know what students are learning, but you are also wrong. All we know is that students are learning something."** - Hogan J.— I might get that quote written on my headstone.

## **ONWARDS! - The MathED PLD Hat or Self Development Hat Mathematical Methods**

***Submissions should consist of methods, procedures, and reasoning related to the following:***

### ***Number:***

***Inverse percentage change, proportion (including scale diagrams), and more complex rates and ratios.***

***Negative and fractional powers.***

***Scientific form.***

### ***Algebra:***

***Manipulating and using formulae.***

***Manipulating and simplifying expressions.***

***Inequations.***

***Quadratic and more complex linear equations.***

***Simultaneous linear equations with two unknowns.***

***Optimal solutions.***

***Relating graphs, tables, equations, and patterns.***

***Relating rate of change to the gradient of a graph.***

***Forming, graphing, or manipulating linear or quadratic models.***

### ***Measurement:***

*Surface area of prisms, pyramids, cones, and spheres.  
Volume of pyramids, cones, spheres, and composite shapes including prisms.  
Conversions between more complex metric units such as area, volume, and  
derived measures such as km/h.  
Geometry and Space:  
Properties of similar shapes.  
Pythagoras' theorem.  
Trigonometric ratios in right-angled triangles.*

*Selection of evidence for submission is to be carried out by the student.*

These are the Mathematical Methods specifically mentioned in the Assessment Description of the new Achievement Standards. Notice the word "related" in the first sentence. There are others. There are thousands of Mathematical Methods in fact. Examples of these should be discussed and refined at Department level so everyone is clear about what is expected. On top of these methods are all the problem solving methods we commonly use as mathematicians.

Another quote from the Burgundy Bible page 11.

Teachers can create opportunities for students to develop these characteristics by encouraging them to practise and learn such simple strategies as guessing and checking, drawing a diagram, making lists, looking for patterns, classifying, substituting, re-arranging, putting observations into words, making predictions, and developing proofs.

### **Some examples**

#### **Number**

The price of an item before GST was added is an example of an **inverse percentage change**. Something that is sold for \$123 including GST cost \$106.96 without the GST. This answer includes some sensible rounding.

#### **Algebra**

Taxi A charges a flat rate of \$40 for any journey within the town boundaries. Taxi B charges \$10 plus \$4.50 per kilometre in the same town. Make an estimate of the size of the town.

#### **Measurement**

A basketball is a sphere. Describe a square based pyramid that has the same volume.

#### **Geometry and Space**

Show there are an infinite number of solutions to Pythagorus's Theorem for whole numbers.

These are examples of open and closed problems that could be part of a portfolio if evidence for assessment of the new Math Standard 1.2. Note they do not suggest a method of solution. If an assessment task indicates what to do then it cannot be used for assessment purposes. The Moderators will tell you that.

#### **Problems in Aotearoa**

In my Term 3 News I describe how the two new external standards in maths expect the student to come up with a context and develop problems that could be used for assessment. Not an easy thing for anyone! With teacher help and probably with class friend input as well this might become possible. This is a big ask for a lower ability student who is already struggling with basic math concepts lower than NZC Level 4 and 5.

The teacher can help create the task (DO NOT TELL) and such students can work on the Numeracy and NCEA not just in Year 11 but over a number of years.

The best way to avoid the difficulties that having NZC 1, 2 and 3 students in Year 11 is not

The best way to avoid the difficulties that having NZC L2 and 3 students in Year 11 is not allow that situation to happen. **Work very very hard to lift everyone Y10 student to NZC L4 and above.** My data over 100 schools and 20+ years of gathering the evidence suggests 80%Mult (at or above NZC L4, AsTTLe 4P) in a Y10 cohort or better can be achieved with an unrelenting focus on making every student multiplicative. The invested time pays handsome dividends and students will include mathematics and statistics as part of their career pathway. .

### **Helping a Student**

A student might decide to investigate “**Cars, Cars, Cars**’ like Tina from Turners, as a context. Boys and some girls can be car mad and it is easy to tap into this fascination. It does not take much thinking to come up with some tasks that could provide evidence for the 1.1 and 1.2.

### **Example Tasks a Student might come up with.**

1. How much is an Audi TT?
2. How much does an Audi TT cost to run for a year?
3. I found an old Audi 2008 for \$6000? Is this a good buy?
4. How fast do tyres wear out?
5. Do I need to insure?
6. Is the Audi faster than the Nissan.

Students would come up with a wide range of badly written tasks and it is up to the teacher read, modify and improve these so that there is a good chance of getting suitable evidence for assessment. A good selection of tasks is required but even that does not guarantee a student will use the Mathematical Methods at a suitable level.

### **Example Modified Tasks, from above, that a teacher helps a student to develop.**

1. How do year of manufacture, kilometres travelled, and condition compare to price for the Audi TT's advertised on Trade Me at the moment? You might like to add other sources of car sales. Turners and Classic Cars Mag for example. The Audi TT is a two door sports coupē so you might like to add other similar purposed cars.
2. What much does a car like an Audi TT cost to run for a year? Include as many aspects as you can and estimate for a number of different scenarios. State all your assumptions.
3. Is it better to buy an older cheaper car or a newer more expensive car? This investigation will involve repairs and replacements as parts wear out. Use a spreadsheet?
4. How much rubber comes of a car tyre when it revolves once? Make sure you list assumptions.
5. What insurance company will give me the best deal? Explore different insurance company websites to try and find the answers here. Usually there is an online quote system which is quite user friendly. A selection of five or so companies would be needed. You can call some companies.
6. How does my 2008 Audi TT compare performance with economy wise with a late model similar car. Graphs of power, acceleration, braking, fuel economy and speed are all possible here.

In a project school I have the young women in the TPU came up with “My First Birthday” as a context. When we talked with them about that they described the cake, inviting

friends, putting on entertainment, hiring a hall, graphs of weight gains, birthday presents and a myriad of other things that I did not even consider. It did not take very long to develop some very useful tasks that easily encompassed many of the Mathematical Methods mentioned in the standard. They have a vested interest in this context and will all succeed.

### Math ED HAT

**Always keep an inquiring and open mind as to all aspects of Math ED. Be brave and explore ideas and new approaches. Keep a journal.**

### General Comment

It is now the start of Term 4 and I have to publish. It will be very interesting to see what happens with the new standards. Schools who are turning their backs on these new opportunities are being disappointingly traditional, unimaginative and will keep developing the past. These changes are about new interpretations of mathematics to bring our young people into our new and very modern world. Tomorrow will always bring new challenges and require new solutions. We all have to embrace the future with a positive "I can" attitude or we are doomed to repeat the lessons of the past.

Keep a firm hold on the Big Picture of Human Existence and New Zealand. There are things happening in our pretty special place in the Universe that are not helping preserve and protect a future for all. There are also many things happening that are very futuristic, positive and inspirational. The basic requirements for human existence remain in terms of safety, shelter, warmth and food and this will not change. Being curious, learning, having fun and persevering all give purpose to our lives. The more maths you know the more maths you will use. Being learned about words, science and technology can only be a benefit to all.

I am a strong advocate of a comprehensive OUTDOOR ED experiences to develop survival skills, endurance, be at ease with nature and enjoy a bit of exercise. This could also be a context for the Math Standards.

## NEW Erupt Education Facilitators -

<https://sites.google.com/view/erupteducation/home>



Erupt first newsletter

.pdf

1.8 MB



Some unexpected things happen as a result of being a facilitator and working with teachers. I worked with James and Kris (see the ERUPT FIRST Newsletter) as part of their emerging STEM project development in a Taupo school a few years back. They are very creative, highly focused, highly energised and deeply passionate about their work. I helped them decide to become registered facilitators like myself and work with others to share their passion and knowledge. As I mentioned above, you might think you know what you are teaching but you are wrong. I thought I was helping them develop their work but I might have also helped them see a different future. Teachers are very talented people. I wish James and Kris every success and they will be that. **What they need are a few school PLD contracts to help them get started and independent.**

STEM or STEAM as it is sometimes called is a very good combination of project based science maths language and technology. Kris and James have crafted the **Explore** -



science, maths, language and technology. The end result has been the **Discover - Innovate** approach and witnessing the students of all abilities working together in groups is really nice to experience. Some schools have opted for Hubs, others Themes. This one works and has facilitators who can work with teachers.

**Jim Hogan**

**Accredited Facilitator ACC 572**

[Jim's Website](http://schools.reap.org.nz/advisor/) <http://schools.reap.org.nz/advisor/>

[Teaching Maths Book](#)

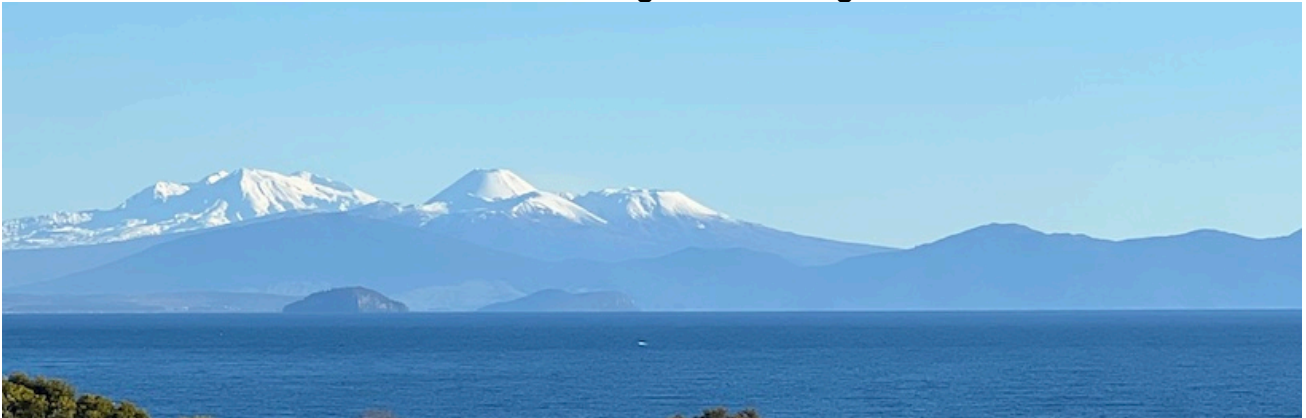
[Problem Based Learning Resources](#)

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### **Mathematics is Thinking and Thinking is Mathematics**



**Lake Taupo, NZ, SEPT 2023**

**How much water is there in the Lake?**

**1km<sup>3</sup>, 10km<sup>3</sup>, 100km<sup>3</sup> or 1000km<sup>3</sup>**







