Te Poutāhū
Curriculum Centre

Mathematics and statistics

THE NEW ZEALAND CURRICULUM REFRESH

Te Tāhuhu o te Mātauranga
Ministry of Education

Te Kāwanatanga o Aotearoa
New Zealand Government

Purpose statement for mathematics and statistics

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

This whakataukī celebrates intricacy, complexity, interconnectedness, and strength. The learning area of mathematics and statistics weaves together the effort and creativity of many cultures that over time have used mathematical and statistical ideas to understand their world.

Mathematics and statistics enables ākonga to appreciate and draw on the power of abstraction and symbolic representation to investigate, interpret, and explain patterns and relationships in quantity, space, time, data, and uncertainty. Like mathematics and statistics, mātauranga Māori is a body of knowledge with a history and a future. When we afford mana ōrite to mātauranga mathematics and statistics and mātauranga Māori while retaining their distinctiveness, ākonga can draw from both in ways that are beneficial to both spheres of knowledge.

The learning area has been designed to support the vision of Mātaitipu and reflects the four kinds of value each learning area contributes: personal value, participatory value, pathways value, and planetary value. Collectively, these express the richness and value of mathematics and statistics learning for ākonga. Ākonga discover inherent personal enjoyment and satisfaction in persistence, solving problems, identifying patterns, and seeing the beauty in mathematics and statistics. They come to appreciate the everyday use of mathematical and statistical tools in, for example, personal finance, music and dance, estimation, and measurement. They recognise how their culture is included and valued in the learning area.

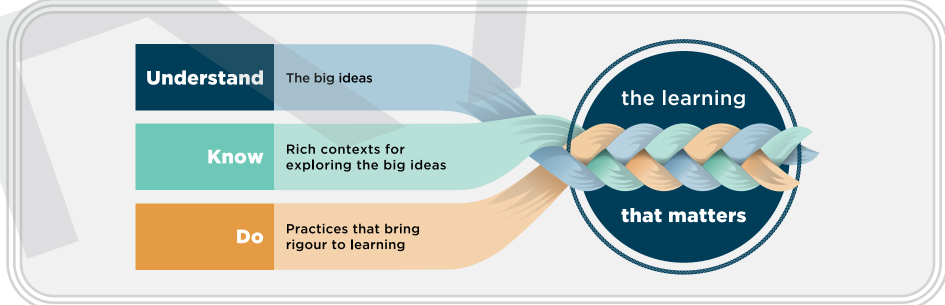
Ākonga participate as they take part in discussions with their peers about their mathematical and statistical thinking and the thinking of others. They discuss and take action on important social matters such as the ethical gathering, interpretation, and communication of data, and challenging misinformation and disinformation. They also engage with diverse cultural perspectives, including te ao Māori and Pacific world-views, on being numerate in Aotearoa New Zealand.

Through the learning area, ākonga discover pathways into STEAM-integrated careers and opportunities across a wide range of industry sectors. They build a base of knowledge that supports Māori and Pacific aspirations and priorities and helps them function in our increasingly technology- and information-rich world of work.

Ākonga also come to understand the value of mathematical and statistical modelling as a lens for resolving collective global challenges – for example, in adapting to and mitigating climate change and in helping to build an equitable, sustainable future for all.

Learning in mathematics and statistics builds both literacy and numeracy. Mathematics and statistics contribute to ākonga literacy by developing their skills in oral and written communication, meaning-making, and the use of specific vocabulary and symbols. Statistics and probability, in particular, support the understanding of tables, graphs, and diagrams as well as critical thinking about the quality of data and stories told about it.

As this whakataukī tells us, connections between different concepts, knowledge, and practices are central to mathematics and statistics. Kaiako weave together the elements of Understand, Know, and Do to ensure ākonga learn mathematics and statistics as a connected body of knowledge.



Important considerations for teaching mathematics and statistics

The most effective teaching of mathematics and statistics follows a strengths-based approach that creates opportunities for all students to learn and progress. Such an approach recognises that all ākonga are culturally located and includes parity for mātauranga Māori.

It is important for teaching to be ambitious within and potentially beyond each phase of learning. When designing a mathematics and statistics programme, kaiako need to plan for providing ākonga with multiple opportunities to progress.

Learning happens best when mathematics and statistics are taught daily, using purposeful tasks related to both mathematical contexts and wider contexts relevant to the communities, cultures, interests, and aspirations of ākonga.

When planning how to support progress, kaiako can ask: What opportunities do ākonga have to:

- learn new mathematics and statistics concepts and practices?
- use mathematics and statistics to investigate relevant tasks?
- communicate and critique mathematical findings and understandings?
- understand the interrelated nature of skills and concepts in mathematics and statistics?
- practise the mathematics and statistics that they have learned?

When planning tasks, kaiako can ask:

- What are the cultural contexts that will resonate with my ākonga?
- How can I support ākonga to engage with a context's whakapapa, tikanga, and significance while honouring and maintaining the integrity of both the mathematics and the context?

As they prepare, kaiako can work through the tasks themselves and ask:

- How can I help ākonga find the joy in this learning?
- How can I help build the resilience of ākonga?
- How can I value and reward persistence?
- How can I help ākonga see the broad relevance of this work to their lives, including purposeful contexts, mathematical skills, social skills, knowledge, cognitive development, and cultural competence?

Overview

Understand
Big ideas

> *Kotahi te kōhao o te ngira e kuhuna ai te miro mā, te miro pango, te miro whero. (Pōtatau Te Wherowhero)*
>
> *There is but a single eye of the needle through which white, black, and red threads must pass together, yet each thread keeps its own colour and integrity while adding its strength and beauty to the others.*

The interface between mātauranga Māori and mātauranga mathematics and statistics offers opportunities for insights that uphold the integrity of each knowledge system.

Mātauranga Māori and mathematics and statistics are different systems for viewing, understanding, and organising the world and for guiding how we operate within it. Mātauranga Māori makes meaningful and distinctive contributions to mathematical inquiry and knowledge in Aotearoa New Zealand, just as mathematical and statistical insights contribute to mātauranga Māori. When considering concepts, processes, and artifacts from te ao Māori, we maintain their integrity by exploring the mātauranga Māori associated with them before formulating mathematical and statistical hypotheses about them.

> *Nō ngā tūpuna, tuku iho, tuku iho.*
>
> *The human ideas that have been passed down from generation to generation can help us develop our thinking today.*

Mathematics and statistics have a continuous, evolving human history.

Mathematics and statistics have been constructed over thousands of years across the globe as we have grappled with notions of quantity, numerical representation, measurement, dimension, and pattern. They continue to be constructed from ideas drawn from many cultures. In Aotearoa New Zealand, our location in Te Moana-nui-a-Kiwa – with its multiple cultures, artifacts, and knowledges – contributes to mathematics and statistics.

> *Whiria te kaha tūātinitini, whiria te kaha tūāmanomano.*
>
> *Together we can use our strengths to achieve more. All learning contributes specific threads that we can use to weave a rope strong enough to get us where we want to go, do what we want to do, and be what we want to be.*

The world is full of patterns and structures that we use mathematics and statistics to understand.

Mathematics and statistics enable us to notice, explore, and describe similarities, regularities and irregularities, and trends in the natural, mathematical, technological, and social worlds. They provide tools and ways of working that can reveal patterns and structures useful for decision making, understanding and predicting phenomena, and creating new insights.

Know
Contexts

Mātauranga tau | Number
Cultures use *Number* to represent, describe, and compare quantities. We operate on these quantities, and use them to estimate, calculate, reason, and justify.

Taurangi | Algebra
Algebra focuses on making and using generalisations to reason mathematically, and on identifying patterns and underlying mathematical relationships. These generalisations, patterns, and relationships can be represented and communicated using diagrams, graphs, and symbols (including variables).

Ine | Measurement
Measurement provides the tools and concepts for quantifying phenomena in the world by estimating, measuring accurately, and using appropriate units, including those from Māori, Pacific, and metric systems of measurement. Many cultures use both standard and non-standard units to measure tangible and intangible quantities.

Mokowā | Space
Space focuses on visualising, representing, and reasoning about the shape, position, orientation, and transformation of objects. It takes account of tools and techniques from the natural world used by many cultures.

Tauanga | Statistics
Statistics focuses on tools, concepts, and systematic process for interpreting situations, using data and its context to understand uncertainty and make predictions. Every piece of data is a taonga to be kept safe and treated ethically and respectfully.

Tūponotanga | Probability
Probability focuses on tools and concepts for quantifying chance, dealing with expectation, and using evidence to identify how likely events are to occur. Probabilistic thinking is evident throughout tikanga and mātauranga Māori.

Do
Practices

Te hoahoa pūāhua mō te pāngarau me te tauanga | Formulating situations mathematically and statistically
Recognising when to use mathematics and statistics is the first step in investigating a situation. The next step is deciding which approaches, concepts, and tools to use and how to use them. Sometimes this will involve translating words into mathematical symbols. Identifying assumptions and constraints supports estimation, reasoning, and sense-making. Māori, Pacific, and other world-views may offer other ways of understanding a situation.

Te whakamahi me te tūhono i ngā huatau, ngā meka me ngā aramahi pāngarau, tauanga hoki | Using and connecting mathematical and statistical concepts, facts, and procedures
Investigating situations involves using concepts, facts, and procedures to find regularities, trends, variations, and patterns. Making connections between concepts, facts, and procedures from different areas of mathematics and statistics helps deepen conceptual understandings. Different forms of representation and tools, including technologies, can help us make connections and generate insights.

Te whakatauwhānui i ngā kitenga pāngarau me ngā kitenga tauanga | Generalising mathematical and statistical findings
Noticing regularity and structure during an investigation and when constructing an argument allows us to generalise mathematical ideas from familiar to novel contexts. Moving beyond immediate solutions by identifying patterns and relationships deepens mathematical and statistical understandings and extends their power and usefulness. In statistics, noticing trends and variation in data allows us to make inferences and predictions and to articulate data-based claims about similar situations.

Understand
Big ideas

> ***Kei hopu tōu ringa ki te aka tāepa, engari kia mau ki te aka matua.***
>
> *Do not catch hold of the loose vine but lay hold of the main vine. You can use the strength of the aka matua (main vine) for the sure footing you will need to reach for new ideas and to climb to new heights.*

The world is characterised by change and variation that we use mathematics and statistics to understand.

The world embodies a multitude of temporary and permanent relationships in which change and variation occur. Some relationships are linear; others are exponential. Mathematics and statistics enable us to systematically describe and analyse different types of change and variation, and to generate insights and make predictions about them.

> ***Ko te pae tawhiti whāia kia tata, ko te pae tata whakamaua kia tina.***
>
> *Seek to bring distant horizons closer and cherish those that you have attained. There will always be pae tawhiti, the 'not yet', but we can move ever closer to that for which we strive.*

Mathematical and statistical logic and reasoning enable us to identify and explain relationships and to justify conclusions.

Reasoning from observation (induction) and reasoning from theory (deduction) allow us to explore situations using mathematics and statistics. Mathematical and statistical logic and reasoning differentiate what is probable from what is possible and allow us to draw reliable conclusions about what is reasonable or not.

Know
Contexts

Do
Practices

Te whakamārama, te parahau me te arotake i ngā kitenga pāngarau me ngā kitenga tauanga | Explaining, justifying, and evaluating mathematical and statistical findings

Explaining and justifying use representations (including from digital tools), specialist vocabulary, and symbols to communicate mathematical and statistical ideas. Justifications also consider reasonableness, forms of argument, and standards of evidence. Evaluating involves reflecting upon mathematical solutions, results, or conclusions, determining whether they are reasonable and make sense in context, and offering critiques of others' reasoning and inferences.

Progress outcome by the end of **year 3** (Foundation)

Te tupu pāhautea i te taiao ako e haumako ana i te reo matatini me te pāngarau **|** *Thriving in environments rich in literacy and numeracy*

Understand

I am building knowledge about number, algebra, measurement, space, statistics, and probability, and drawing on the practices of mathematics and statistics.

Through this, I am deepening my understanding that:

> ***Kotahi te kōhao o te ngira e kuhuna ai te miro mā, te miro pango, te miro whero.***

The interface between mātauranga Māori and mātauranga mathematics and statistics offers opportunities for insights that uphold the integrity of each knowledge system.

> ***Nō ngā tūpuna, tuku iho, tuku iho.***

Mathematics and statistics have a continuous, evolving human history.

> ***Whiria te kaha tūātinitini, whiria te kaha tūāmanomano.***

The world is full of patterns and structures that we use mathematics and statistics to understand.

Know

I know that:

Mātauranga tau | Number

Numbers can be composed (put together) and decomposed (taken apart) in different ways by using patterns

In base 10, there are 10 digit symbols (0-9) and their value is defined by their position within a number. Digits in any column are worth 10 times as much as those in the column to the right.

Te reo Māori and other Pacific languages explicitly describe the logic of the base 10 numbering system, showing groups of hundreds, tens, and ones.

Fractions show parts of a whole in an area, a measurement, or a set of objects. They can be described in words, pictorially, or symbolically; when represented symbolically, each part of the fraction tells a story.

The same amount (e.g., a half or a quarter) can be shown by equivalent fractions.

Taurangi | Algebra

Patterns have a whakapapa. They are made of numeric or spatial elements in a sequence governed by a rule. Sometimes they repeat and sometimes they continue, and they can be translated into different forms.

An algorithm is a sequence of rules that can be followed.

Addition and subtraction ‘undo’ or ‘reverse each other. Similarly, multiplication and division ‘undo’ or ‘reverse each other (the inverse property).

Addition and multiplication are commutative; that is, numbers can be combined in any order (e.g., 3 + 7 = 7 + 3; 3 × 7 = 7 × 3).

The equals sign is a relational symbol that shows that the two sides of an equation are balanced or the same.

Ine | Measurement

Systems of measurement have a history. Different cultures use different approaches to measuring.

To measure objects, we use the same measurement unit repeatedly, with no gaps or overlaps. The measurement is the total number of units used.

Covering things gives area, filling things gives capacity or volume.

Do

Te hoahoa pūāhua mō te pāngarau me te tauanga | Formulating situations mathematically and statistically

I can:

- plan an approach to situations involving:
  - whole numbers to 10,000
  - fractions
  - turns
  - relative positions on models and maps
  - measurement with standard units
- decide how to represent situations using words, diagrams, symbols, and equations
- make an initial estimate of discrete and continuous quantities (i.e., numbers of separate items, and amounts of something)
- formulate a familiar routine or basic task as a set of precise, step-by-step instructions (an algorithm)
- make predictions about movements (e.g., turns) and distance travelled in space
- generate summary investigative questions for data-based investigations based on noticing and wondering within everyday situations
- pose questions for chance-based investigations about games and everyday situations, plan to collect the data, and anticipate what might happen.

Te whakamahi me te tūhono i ngā huatau, ngā meka me ngā aramahi pāngarau, tauanga hoki | Using and connecting mathematical and statistical concepts, facts, and procedures

I can:

- use different approaches to group, partition, and recombine numbers to 1,000, and make connections between the approaches
- use number patterns and an understanding of operations to solve with words, pictures, and symbols:
  - addition and subtraction problems with two- and three-digit numbers
  - multiplication problems involving single digit numbers and a single digit by a two-digit number
  - division problems (involving whole numbers, a single-digit divisor, and no remainders)
  - addition of fractions with 1 in the numerator (unit fractions) and with the same denominator
- use understanding of the equals sign to solve true-false and open number sentences
- give instructions for moving an object to a different location
- collect, sort, and record data for categorical variables to support answering summary investigative questions
- create data visualisations using categorical data and describe what they show.

Understand

Kei hopu tōu ringa ki te aka tāepa, engari kia mau ki te aka matua.

The world is charaterised by change and variation that we use mathematics and statistics to understand.

Ko te pae tawhiti whāia kia tata, ko te pae tata whakamaua kia tina.

Mathematical and statistical logic and reasoning enable us to identify and explain relationships and to justify conclusions.

Know

Mokowā | Space

There are patterns and regularities in shapes (e.g., horizontal and vertical lines of symmetry) that can be used to compare, classify, and predict.

Two-dimensional shapes can be joined or partitioned to form new shapes and can have both reflection and rotation symmetry.

Flip (reflection), turn (rotation), and slide (translation) are found in objects and structures and can be used to create patterns.

Objects can be rotated; they may then look different, but they are the same.

A position can be described using references to known environmental features; this is a kind of map.

Maps are two-dimensional representations of locations and places in the real world. They use symbols to show landmarks.

Tauanga | Statistics

People and the environment are not data, but data can tell us things about people, their lives, and their environment.

Data is information about the world and comes in many forms (e.g., physical or digital objects or images).

The Problem, Plan, Data, Analysis, Conclusion (PPDAC) statistical enquiry cycle supports the use of summary questions to investigate individuals and groups and the creation of categorical variables to classify objects or subjects into collections.

Data visualisations are representations of all available values of one or more variables that reveal relationships or tell a story.

Tūponotanga | Probability

An event is a situation that has more than one possible outcome. The probability of each outcome is the chance of it occurring.

The PPDAC statistical enquiry cycle supports chance-based investigations for predicting outcomes of everyday situations and activities and whether they are certain, likely, possible, unlikely, or impossible.

Do

Te whakatauwhānui i ngā kitenga pāngarau me ngā kitenga tauanga | Generalising mathematical and statistical findings

I can:

- notice and make statements about how relationships and patterns in numbers can help solve equations
- notice the properties of addition and subtraction, express conjectures about these, and develop them into generalisations using examples or symbols
- generalise a rule about a pattern by finding the next element and later elements
- create and test algorithms that sort numbers into categories
- compare and classify two- and three-dimensional shapes
- make statements about patterns in categorical data and chance-based investigations.

Te whakamārama, te parahau me te arotake i ngā kitenga pāngarau me ngā kitenga tauanga | Explaining, justifying, and evaluating mathematical and statistical findings

I can:

- justify estimates and predictions involving quantities, measurements, and spatial objects
- explain and justify choices for calculating and measuring, findings, and results
- explain observations and findings about patterns and rules, two- and three-dimensional shapes, and data and data visualisations
- represent and read the time on an analogue or digital clock for hours, half hours, and quarter past or quarter to the hour
- explain findings by identifying and describing changes (e.g., how a pattern works, how shapes have been transformed, or how likely an outcome is to occur)
- evaluate and suggest improvements to a process after checking findings
- evaluate findings by considering the reasons and evidence for them
- listen to others, explain their ideas, and consider how their thinking differs from mine.

Progress steps

Progress steps are essential, time-sensitive aspects of learning. As ākonga work towards a progress outcome, kaiako can use progress steps to notice, recognise, and respond to their learning in a timely fashion.

Mathematics and statistics progress step **during the first six months**

Building on the foundation from early learning, ākonga can:

- recognise instantly the total number of objects in a group of up to six (i.e., subitise)
- join and separate groups of up to a total of 10 objects, and find the result by grouping and counting
- copy and continue or create and describe a repeating pattern with two elements
- compare directly two objects by an attribute (e.g., length, weight, capacity)
- sort objects by one feature (e.g., colour, shape), identifying the feature chosen
- compose by trial and error an outlined target shape using smaller shapes, and decompose a shape into smaller shapes
- follow an instruction to move themselves and locate objects.

Mathematics and statistics progress step **during the first year**

Building on their progress from previous months, ākonga can:

- recognise instantly the total number of objects in two patterns, each of up to five objects, by mentally combining them (i.e., subitise)
- partition and recombine sets of up to 10 in different ways
- join separate groups, and find the difference between groups by grouping or counting
- solve multiplication and division problems by making equal groups and using grouping or counting
- recognise, and represent in different ways, halves and quarters of sets and regions
- sort and re-sort shapes and objects by features, identifying the feature chosen
- compare the length, weight, volume, and capacity of objects indirectly (i.e., by comparing each of them with another object)
- visualise which smaller shapes might compose a target shape, and check by composing the shape
- give instructions to locate an object or move to a location.

Mathematics and statistics progress step **during the second year**

Building on their progress from the previous year ākonga can:

- partition a pattern of up to 10 objects into subgroups, instantly recognise the number of objects in each subgroup, and then give the total number in the pattern by referring to the numbers in the subgroups
- group, partition, and recombine whole numbers up to 100
- recognise the relationships between related fractions (e.g., three halves and six quarters)
- show that in an equation, both sides of the equal sign represent the same quantity
- use both the unit of repeat and the ordinal position (e.g. first, second, and third) of a repeating pattern to predict further elements
- use a standard informal unit repeatedly to measure the length, weight, volume, and capacity of an object
- plan how to use smaller shapes to compose a larger shape, and then compose the shape
- give and follow movement instructions that involve direction, distances, and half and quarter turns
- collect, sort, and display category data
- describe what they notice in data displays
- identify possible outcomes for familiar activities and events involving chance.

Progress outcome by the end of **year 6**

***Te whakawhānui i ngā pae o te mātauranga me te mahi tahi** | Expanding horizons of knowledge and collaborating*

Understand

I am building knowledge about number, algebra, measurement, space, statistics, and probability, and drawing on the practices of mathematics and statistics.

Through this, I am deepening my understanding that:

> ***Kotahi te kōhao o te ngira e kuhuna ai te miro mā, te miro pango, te miro whero.***

The interface between mātauranga Māori and mātauranga mathematics and statistics offers opportunities for insights that uphold the integrity of each knowledge system.

> ***Nō ngā tūpuna, tuku iho, tuku iho.***

Mathematics and statistics have a continuous, evolving human history.

> ***Whiria te kaha tūātinitini, whiria te kaha tūāmanomano.***

The world is full of patterns and structures that we use mathematics and statistics to understand.

Know

I know that:

Mātauranga tau | Number

Te reo Māori and Pacific languages use a base 10 numbering system that is explicit about groups within whole numbers and decimals.

Fractions, decimals, and percentages are all ways of showing parts of numbers.

Depending on the context, a fraction can describe a measure, a proportional relationship, or an action on another number.

Fractions express ways of sharing that may be different from sociocultural norms, particularly within tikanga and mātauranga Māori.

Fractions can be larger than 1.

Decimals are a set of fractions that have powers of 10 as their denominators (e.g., $\frac{7}{10}$ or $\frac{7}{100}$) and that can be written as numbers using a decimal point (e.g., 0.7 or 0.07).

A percentage is the number of 100ths of a whole (e.g., $\frac{7}{100}$ is 7%).

Taurangi | Algebra

In a pattern, the relationship between the ordinal position (e.g., first, second, and third) and the corresponding element is more useful for finding the pattern's rule than the relationship between successive elements.

The equals (=) and inequality (<, >) signs show relationships.

Applying the same operation to both sides of an equation keeps things equal.

Addition and multiplication are associative, so numbers can be grouped and combined in any way (e.g., $3 \times (7 \times 5) = (3 \times 7) \times 5$).

Multiplication is distributive over addition and subtraction (e.g., $3 \times (10 + 7) = (3 \times 10) + (3 \times 7)$).

The language of algebra is the basis of computer programming.

Ine | Measurement

Mātauranga Māori draws on knowledge of te taiao and has ways of measuring things that are meaningful (e.g., Maramataka).

Appropriate metric units are used to quantify length, area, volume, capacity, mass, and duration.

Measurements can contain units and parts of units, and need the unit recorded with the amount (e.g., 1.3 km or 2 hours and 45 minutes).

Do

Te hoahoa pūāhua mō te pāngarau me te tauanga | Formulating situations mathematically and statistically

I can:

- plan an approach to situations involving:
  - fractions, decimals, and percentages
  - location
  - design using spatial knowledge
- use words, symbols, and equations to create or explore situations involving multiplication and division and in which equal groups, rates, comparisons, part-whole relationships, areas, or volumes play a part
- plan an approach to situations involving time measurements, including analogue and digital clocks, 12- and 24-hour time, weeks, months, and longer measurements of duration
- explore perimeters, areas, nets (for cuboids), symmetries, and transformations by visualising two- and three-dimensional shapes from different perspectives
- decide how to approach and represent a situation involving an algorithm by selecting actions, putting them in sequence, and repeating the sequence to create a loop
- pose investigative questions in relation to school contexts and plan for collecting data, including who to collect information from, what to measure, and how to measure
- recognise a chance-based claim, or identify a question that involves a one-stage chance situation and plan a probability experiment to investigate it.

Te whakamahi me te tūhono i ngā huatau, ngā meka me ngā aramahi pāngarau, tauanga hoki | Using and connecting mathematical and statistical concepts, facts, and procedures

I can:

- use different approaches to group, partition, and recombine whole numbers and decimals to three places, and make connections between the approaches
- use number patterns to solve addition and subtraction problems involving any whole numbers, decimals to two places, and fractions with like denominators
- use the distributive property, the inverse relationship between multiplication and division, and basic facts to multiply two- and three-digit numbers, multiply fractions and whole numbers, and divide whole numbers by one- or two-digit divisors
- use a number line to compare and order fractions, decimals (to two places), and percentages
- find the factors and multiples of numbers up to 100, the perimeter and area of rectangles, and the volume of rectangular prisms
- use understanding of equality and inequality relationships to solve true-false and open number sentences
- estimate length, area, volume, capacity, mass, and duration sensibly and measure them accurately

Understand

Kei hopu tōu ringa ki te aka tāepa, engari kia mau ki te aka matua.

The world is charaterised by change and variation that we use mathematics and statistics to understand.

Ko te pae tawhiti whāia kia tata, ko te pae tata whakamaua kia tina.

Mathematical and statistical logic and reasoning enable us to identify and explain relationships and to justify conclusions.

Know

The line around a two-dimensional shape is its perimeter.

Angles are a measurement of turn; 90 degrees is a quarter turn, 180 degrees is a half turn, and 360 degrees is a full turn.

Mokowā | Space

Two- and three-dimensional shapes have consistent properties that can be used to define, compare, classify, predict, and identify relationships between them.

Shapes can be rotated, reflected, translated, enlarged, and reduced.

Viewing objects from different angles gives different perspectives.

Position can be described using known environmental features and signs from te taiao.

Maps use grid references or coordinates to specify places and scales to show distances.

Mātauranga Māori often identifies location in the natural world as a form of mapping.

Tauanga | Statistics

Data about people and te taiao can have negative impacts and so must be collected, used, and stored carefully.

The Problem, Plan, Data, Analysis, Conclusion (PPDAC) statistical enquiry cycle supports summary, comparison, and time-series investigations (e.g., about school-related matters).

Different data visualisations for the same data can lead to different insights.

Tūponotanga | Probability

The PPDAC statistical enquiry cycle supports chance-based investigations for a claim or question about the likelihood of an event happening.

Probabilities and the language of probability are associated with values between 0 or 0% (impossible) and 1 or 100% (certain).

Some probabilities are theoretical and some are estimated from probability experiments.

A probability experiment involves repeated trials. The experimental probability of an event is the number of times the event occurs divided by the total number of trials.

Do

- use grid references, compass points, distance, and turns to locate positions and paths
- create designs using transformations including symmetry, translation, and rotation
- collect and record data for numerical variables, using data cards, tables, or spreadsheets and checking for errors
- list possible outcomes for an experiment and estimate their probabilities.

Te whakatauwhānui i ngā kitenga pāngarau me ngā kitenga tauanga | Generalising mathematical and statistical findings

I can:

- notice patterns in and form generalisations about equivalent fractions
- notice the properties of multiplication and division, express conjectures about these, and develop generalisations using examples or symbols
- notice and make statements about how the order of operations and relationships and patterns in numbers can help solve equations
- find a rule for any term in a number pattern and use the rule to make predictions
- notice regularity in a linear pattern and describe it using words
- make statements about similarities and differences across various measurements or shapes
- compare and classify shapes using their properties
- make statements about patterns in data- and chance-based investigations
- informally draw conclusions or make predictions about a wider group, based on the group from which data was originally collected.

Te whakamārama, te parahau me te arotake i ngā kitenga pāngarau me ngā kitenga tauanga | Explaining, justifying, and evaluating mathematical and statistical findings

I can:

- explain and justify choices for calculating and measuring, findings, and results
- represent patterns using tables, XY-graphs, and diagrams
- represent three-dimensional shapes from different viewpoints using drawings, models, and digital tools
- explain and justify findings when manipulating and visualising shapes that do or do not change when reflected, rotated, translated, enlarged, or reduced
- critique others' reasoning and interrogate their arguments, deciding whether they make sense and asking questions to help clarify or improve them
- create data visualisations to explain findings from data- and chance-based investigations
- discuss others' conclusions about data- and chance-based situations, justifying opinions with reasons, logic, and evidence
- notice similarities and differences between experimental and theoretical probabilities.

Progress steps

Progress steps are essential, time-sensitive aspects of learning. As ākonga work towards a progress outcome, kaiako can use progress steps to notice, recognise, and respond to their learning in a timely fashion.

Mathematics and statistics progress step **during year 4**

Building on their progress from the previous year, ākonga can:

- use known facts to derive unknown facts involving addition or subtraction and multiplication or division
- use the relationship between multiplication and division to solve division problems
- solve open number sentences using the relationship between the two sides of the equal sign
- discuss what a scale is and how it works when used to describe length and time
- use grid references to identify points on a map
- give directions for moving between points on a grid-referenced map.

Mathematics and statistics progress step **during year 5**

Building on their progress from the previous year, ākonga can:

- group, partition, and recombine whole numbers up to 10,000
- use understanding of the distributive property to solve multiplication problems
- represent improper fractions as mixed fractions
- convert between benchmark fractions, decimals, and percentages (e.g., $\frac{1}{2}$ = 0.5 = 50%)
- represent decimals, fractions, and percentages using both discrete and continuous models and different shapes and containers.

Progress outcome by the end of **year 8**

***Te aro atu ki te ao whānui me te kōkiri kaupapa hei hāpai tahi i ētahi atu** | Seeing ourselves in the wider world and advocating with and for others*

Understand

I am building knowledge about number, algebra, measurement, space, statistics, and probability, and drawing on the practices of mathematics and statistics.

Through this, I am deepening my understanding that:

Kotahi te kōhao o te ngira e kuhuna ai te miro mā, te miro pango, te miro whero.

The interface between mātauranga Māori and mātauranga mathematics and statistics offers opportunities for insights that uphold the integrity of each knowledge system.

Nō ngā tūpuna, tuku iho, tuku iho.

Mathematics and statistics have a continuous, evolving human history.

Whiria te kaha tūātinitini, whiria te kaha tūāmanomano.

The world is full of patterns and structures that we use mathematics and statistics to understand.

Know

I know that:

Mātauranga tau | Number

Numbers can be prime, composite, square, positive, or negative.

When adding a number and its opposite together (e.g., 2 + -2 or -2 + 2), the sum will always be zero (the inverse property).

In equations where there is more than one operation, there are rules for the order in which the operations must be carried out.

Real numbers are continuous (i.e., there are an infinite number of possibilities between, for example, 0 and 1). They can be written as decimals, or as fractions in many ways.

Taurangi | Algebra

Operations on numbers have properties that can be generalised using variables.

Functions are relationships that uniquely associate members of one set with members of another set.

Linear relationships can be shown by an XY-graph, a table, an equation, or in words.

Inequalities can also include equals (≤, ≥) to show a relationship that allows for the possibility of equality.

In algorithms and computer programs, sequencing and iteration use systems thinking (i.e., input-process-output, with feedback loops).

Ine | Measurement

When two line segments meet, they form an angle; if they are perpendicular, the angle is 90 degrees.

Perimeters, areas, and volumes can be calculated by looking for shapes within other shapes.

Base measurements within the metric system (e.g., metre, gram, litre) along with their prefixes (e.g., kilo, centi) show the size of units.

Mokowā | Space

Unknown angles can be found using the properties of straight lines, angles at a point, and vertically opposite angles.

Two-dimensional shapes can be resized by a positive whole number or a fraction (e.g., $\frac{1}{3}$, $\frac{1}{5}$).

Do

Te hoahoa pūāhua mō te pāngarau me te tauanga | Formulating situations mathematically and statistically

I can:

- decide how to approach and represent situations involving conversions between fractions, decimals, and percentages
- use words and symbols to describe situations involving positive and negative numbers, fractions, and linear relationships
- plan an approach to situations involving measurements with metric units, shapes, and position
- pose investigative questions about local rohe or community matters, make a plan to ethically collect or source data on these matters, determine the groups and variables of interest, and make conjectures about what might be found
- pose investigative questions for one- and two-stage chance situations, anticipate what might happen if the number of trials is increased, and plan the investigation.

Te whakamahi me te tūhono i ngā huatau, ngā meka me ngā aramahi pāngarau, tauanga hoki | Using and connecting mathematical and statistical concepts, facts, and procedures

I can:

- use number patterns and an understanding of operations to add, subtract, and multiply with decimals and fractions
- identify divisibility rules and use them to find prime numbers and the factors of composite numbers
- use an understanding of the order of operations and equality and inequality to solve open number sentences
- use trial and improvement and apply inverse operations to solve linear equations of the form a = b + cx
- use variables and symbols to describe functions and relationships and to connect at least two different forms of linear relationships
- estimate and measure length, area, volume, capacity, mass, temperature, data storage, time, and angle, using appropriate metric units and analogue and digital tools
- use the relationships evident in timetables, charts, maps, and te taiao to solve problems involving time, position, and orientation
- create tessellations and other geometric patterns using combinations of transformations (e.g., enlarging objects using a scale factor, or rotating objects by quarter turns)
- sort and classify two- and three-dimensional shapes, using the geometrical properties of triangles, quadrilaterals, and other polygons
- use lists, tables, and digital tools to systematically record data from repeated trials of probability experiments, and then determine the probabilities.

Understand

Kei hopu tōu ringa ki te aka tāepa, engari kia mau ki te aka matua.

The world is charaterised by change and variation that we use mathematics and statistics to understand.

Ko te pae tawhiti whāia kia tata, ko te pae tata whakamaua kia tina.

Mathematical and statistical logic and reasoning enable us to identify and explain relationships and to justify conclusions.

Know

The invariant properties of two-dimensional and three-dimensional shapes do not change under different transformations.

Three-dimensional shapes can be represented by two-dimensional images.

Prisms are solids that are classified by their fixed cross section.

Position, direction, and pathways can be expressed and operated on using coordinate systems, maps, and elements of the environment.

Position, direction, and pathways can be described using te taiao, as in Māori and Pacific systems of knowledge, or using scale and compass points.

Tauanga | Statistics

Many pieces of data have a whakapapa. How and why data about people and te taiao is collected, interpreted, and stored can exclude and harm people as well as include and protect them.

The gathering and use of categorical and numerical data requires the free and prior consent of the people and communities that the data describes.

The Problem, Plan, Data, Analysis, Conclusion (PPDAC) statistical enquiry cycle can be used to conduct data-based investigations about the wider community.

There are different types of questions used when undertaking statistical investigations. These can be investigative (summary, comparison, relationship, time-series), survey, data-collection, interrogative, or analysis questions.

Data visualisations show patterns, trends, and variations. Different visualisations of the same data can lead to different insights and communicate different information.

Tūponotanga | Probability

The PPDAC statistical enquiry cycle can be used to conduct chance-based investigations, using sampling with replacement.

In a probability experiment, when trials are independent, results of past trials do not impact on the results of future trials.

Estimated probabilities, probabilities from experiments, and theoretical probabilities will often differ.

If all possible outcomes in a chance situation are equally likely, the probability of an event happening is a fraction in which the numerator is the number of ways the event can happen and the denominator is the total number of possible outcomes.

Do

Te whakatauwhānui i ngā kitenga pāngarau me ngā kitenga tauanga | Generalising mathematical and statistical findings

I can:

- form generalisations about operations with fractions and with positive and negative numbers, including facts about the commutative, associative, and inverse properties
- notice patterns and form generalisations for adding, subtracting, and multiplying with decimals and fractions
- form generalisations (with variables) about linear patterns, and use them to make predictions
- form generalisations about the area of shapes composed of triangles or quadrilaterals, and about the volume of shapes composed of rectangular prisms
- consider after an investigation whether related groups of interest would have similar or different findings
- propose theoretical probabilities based on estimates from probability experiments.

Te whakamārama, te parahau me te arotake i ngā kitenga pāngarau me ngā kitenga tauanga | Explaining, justifying, and evaluating mathematical and statistical findings

I can:

- explain and justify choices for calculating and measuring, findings, and results, using words, symbols, graphs, diagrams, and models
- explain and justify findings about linear relationships
- justify conjectures about lines and shapes by using angle rules and shape properties
- describe position, direction, and pathways
- follow the arguments of others, asking useful questions about their data-collection methods, data visualisations, and findings
- discuss others' conclusions or claims, identifying misconceptions and justifying opinions with reasons, logic, and evidence
- explain findings from a statistical investigation, referring to context, describing the shape of the distribution of the data, and using data visualisations
- create data visualisations for findings in probability experiments, and identify similarities and differences between the findings and corresponding theoretical probabilities.

Progress outcome by the end of **year 10**

Te whai ahunga, te manaaki i ētahi atu me te mau tonu ki te manawaroa | *Having a purpose and being empathetic and resilient*

Understand

I am building knowledge about number, algebra, measurement, space, statistics, and probability, and drawing on the practices of mathematics and statistics.

Through this, I am deepening my understanding that:

Kotahi te kōhao o te ngira e kuhuna ai te miro mā, te miro pango, te miro whero.

The interface between mātauranga Māori and mātauranga mathematics and statistics offers opportunities for insights that uphold the integrity of each knowledge system.

Nō ngā tūpuna, tuku iho, tuku iho.

Mathematics and statistics have a continuous, evolving human history.

Whiria te kaha tūātinitini, whiria te kaha tūāmanomano.

The world is full of patterns and structures that we use mathematics and statistics to understand.

Know

I know that:

Mātauranga tau | Number

Division of one number, a, by another number, b, is the same as multiplying a by the reciprocal of b (i.e., $a \div b = a \times \frac{1}{b}$).

Decimals can be terminating, repeating, or non-repeating and infinite (irrational numbers).

There are an infinite number of numbers (fractions and decimals) between any two numbers.

Some irrational numbers are represented by special symbols (e.g., $\sqrt{2}$ and π).

Taurangi | Algebra

Functions can be expressed as algebraic expressions, XY-graphs, tables, or in words.

Patterns have rules that can be generalised as functions.

There are many different, equivalent equations for expressing a linear relationship.

Graphs may contain breaks; such graphs can be useful for showing practical situations.

Algorithms can be efficient or inefficient. More efficient algorithms have fewer steps, which can be important for applications of algorithms such as in computer programming.

Ine | Measurement

Resizing a two-dimensional shape changes its perimeter and area. Resizing a three-dimensional shape changes its perimeter, surface area, and volume.

Right-angled triangles have a fixed relationship between their side lengths (Pythagoras' theorem).

The metric system's base unit for time measurement is seconds. Larger units (e.g., minutes, hours) are not based on powers of 10, but smaller durations are (e.g., milliseconds).

Do

Te hoahoa pūāhua mō te pāngarau me te tauanga | Formulating situations mathematically and statistically

I can:

- use words, symbols, and equations to explore mathematical and practical situations involving real numbers, rates, ratios, and functions
- plan how to approach and represent situations involving the order of operations, including positive whole-number exponents, fractions, decimals, and algebraic expressions
- identify how sequence, selection, and iteration are used to create algorithms for generating patterns
- plan an approach to situations involving shapes (e.g., similar shapes, right-angled triangles), durations of time, and locations
- pose summary and comparison investigative questions about populations, and investigative questions that can be answered from time-series and relationship data or through experiments
- make a plan to ethically collect or source data for observational studies and for experiments
- pose investigative questions and design probability experiments and simulations for two-stage chance situations.

Te whakamahi me te tūhono i ngā huatau, ngā meka me ngā aramahi pāngarau, tauanga hoki | Using and connecting mathematical and statistical concepts, facts, and procedures

I can:

- multiply and divide fractions, decimals, and positive and negative numbers
- find the relationship between a position and its corresponding element in linear and simple quadratic patterns
- create multiple forms of a function, make connections between the forms, and identify key features of the corresponding graph
- substitute into, rearrange, and simplify expressions, combining like terms as needed
- use a formula, rule, or equation, solving for unknowns if necessary
- graph and solve linear inequalities on a number line
- use the properties of polygons and circles to find their perimeter or circumference and area, and find the volume and surface area of prisms, including cylinders
- apply Pythagoras' theorem and the properties of similarity, parallel lines, and two-dimensional shapes
- connect three-dimensional shapes with two-dimensional drawings and vice versa
- collect data by making valid and reliable measurements for variables or by sourcing existing data sets
- list the set of possible outcomes in chance situations, or conduct repeated trials for a probability experiment and systematically record data
- find probabilities for the different outcomes from probability experiments and from theoretical chance situations.

Understand

Kei hopu tōu ringa ki te aka tāepa, engari kia mau ki te aka matua.

The world is charaterised by change and variation that we use mathematics and statistics to understand.

Ko te pae tawhiti whāia kia tata, ko te pae tata whakamaua kia tina.

Mathematical and statistical logic and reasoning enable us to identify and explain relationships and to justify conclusions.

Know

Mokowā | Space

A point has zero dimensions, a line has one dimension, a plane is two-dimensional, and a solid is three-dimensional. In mathematics, there can be more than three dimensions.

In similar shapes, corresponding angles are equal and lengths of corresponding sides are proportional.

Polygons fit together to form three-dimensional shapes, including the platonic solids.

Two-dimensional shapes fit together to form a tessellation when the sum of the interior angles meeting at each vertex equals 360°.

A set of points in the XY-plane can be transformed by translation, reflection about an axis, and rotation about a given point by a multiple of 90.

Tauanga | Statistics

Māori have rangatiratanga over their data, including inherent rights and interests in relation to the collection, use, storage, and ownership of it.

People have rights and obligations in relation to their own data and that of others. Different countries have different laws about data and privacy.

The Problem, Plan, Data, Analysis, Conclusion (PPDAC) enquiry cycle can be used to conduct data-based investigations that involve sampling from populations.

New variables can be created by combining and modifying existing variables.

When sampling from a population, the distribution for a variable varies from sample to sample.

Tūponotanga | Probability

The PPDAC statistical enquiry cycle can be used to conduct chance-based investigations involving simulations.

Theoretical probabilities are underpinned by assumptions. For a given situation, theoretical probabilities and estimates of probabilities from experiments will differ.

Two-stage chance situations can be dependent (leading to conditional probabilities) or independent.

Do

Te whakatauwhānui i ngā kitenga pāngarau me ngā kitenga tauanga | Generalising mathematical and statistical findings

I can:

- form generalisations about the commutative and associative properties when adding and multiplying, and notice limitations with other operations
- form generalisations about the distributive property by noticing patterns from expanding and factorising expressions
- notice that, for all numbers, the additive identity is 0 and the multiplicative identity is 1, and form generalisations to show this, using examples and symbols
- notice patterns and form generalisations for multiplying and dividing exponents with the same base
- form generalisations about properties of similar shapes
- make claims about populations from samples, for summary and comparison situations
- propose theoretical probabilities based on estimates from two-stage probability experiments.

Te whakamārama, te parahau me te arotake i ngā kitenga pāngarau me ngā kitenga tauanga | Explaining, justifying, and evaluating mathematical and statistical findings

I can:

- explain and justify choices for calculating and measuring, findings, and results, using words, variables, graphs, and referring to the context
- explain and justify conjectures about multiplying and dividing with parts of a whole
- justify conclusions about unknown angles and side lengths using Pythagoras' theorem and the properties of similarity, parallel lines, and two-dimensional shapes
- describe the transformation of a set of coordinates in the XY-plane and identify their invariant properties
- interpret and describe locations on a map by calculating distances using map scales and by giving directions using one or more compass bearings
- create data visualisations to analyse data and describe their features, patterns, or trends in context
- answer investigative questions, using evidence from analysis, linking statements to the context, reflecting on conjectures, and providing possible explanations for findings
- answer investigative questions in probability experiments, comparing findings with those of others and with corresponding theoretical probabilities
- discuss others' findings, conclusions or claims, identifying misconceptions and justifying opinions with reasons, logic, and evidence.

Progress outcome by the end of **year 13**

***Te whakatere ara me te whakawhanake kahawhiri hei tautoko i te tāraitanga o āpōpō** | Navigating pathways and developing agency to help shape the future*

Understand

I am building knowledge about number, algebra, measurement, space, statistics, and probability, and drawing on the practices of mathematics and statistics.

Through this, I am deepening my understanding that:

> ***Kotahi te kōhao o te ngira e kuhuna ai te miro mā, te miro pango, te miro whero.***

The interface between mātauranga Māori and mātauranga mathematics and statistics offers opportunities for insights that uphold the integrity of each knowledge system.

> ***Nō ngā tūpuna, tuku iho, tuku iho.***

Mathematics and statistics have a continuous, evolving human history.

> ***Whiria te kaha tūātinitini, whiria te kaha tūāmanomano.***

The world is full of patterns and structures that we use mathematics and statistics to understand.

Know

I know that:

Mātauranga tau | Number

Geometric sequences can be generated using recursion, and they can help model exponential growth and decay.

Sums or series can be represented using sigma notation.

The square root of negative one ($\sqrt{-1}$) is represented by the symbol i.

Taurangi | Algebra

The zero-product property says that if two expressions multiply to be zero, then one or the other is zero; this property is useful for solving algebraic equations.

Equations can undergo a variety of transformations while preserving the same solutions.

A formula can include multiple parameters and variables, which are represented in different ways depending on the context in which the formula is being used.

Transformations of functions have predictable effects on the representations of the function.

Functions can be combined to create new functions by operating on them, including through function composition.

The derivative of a function can be interpreted as its rate of change.

The chain rule helps in the differentiation of composite functions.

The indefinite integral is the antiderivative; the derivative of the indefinite integral is the original function.

Ine | Measurement

A point on a unit circle at an angle of θ with the positive x-axis (in standard position) is represented by the coordinates ($\cos\theta$, $\sin\theta$).

The area under a curve between two points can be calculated by finding the definite integral between the two points.

Mokowā | Space

At a single point, the derivative of a function equals the gradient of the tangent line. This can be interpreted as the rate of change of the function at that point.

Tangent lines are local approximations of a function. Near a specific point, the tangent line and the function have approximately the same graph.

Do

Te hoahoa pūāhua mō te pāngarau me te tauanga | Formulating situations mathematically and statistically

I can:

- plan an approach to situations that involve functions, rate of change, and area under the curve
- use words, symbols, and equations to write, explore, and describe mathematical and practical situations involving functions
- represent functions in different forms, using them to formulate alternative approaches to situations involving functions or linear equations with three variables
- describe kinematic problems involving derivatives and integrals by examining displacement, velocity, and acceleration
- produce statistical questions to help solve a practical problem
- determine whether a random sample, an experiment, a secondary data source, or none of these approaches would be suitable for answering an investigative question
- recognise the key features of uniform, binomial, Poisson, and normal probability distributions in different situations.

Te whakamahi me te tūhono i ngā huatau, ngā meka me ngā aramahi pāngarau, tauanga hoki | Using and connecting mathematical and statistical concepts, facts, and procedures

I can:

- rearrange formulae and algebraically solve equations involving polynomial, reciprocal, rational-power, trigonometric, exponential, and logarithmic terms
- differentiate and integrate functions, including polynomial, reciprocal, rational-power, sine, cosine, exponential (with base e), and natural logarithm functions
- examine rates of change to identify intervals where a function increases or decreases, and identify the concavity of the function
- solve algebraically initial-value problems and systems of linear equations
- find and graph inverse functions, limits of functions, and tangents of functions
- create, manipulate, restructure, and merge data from a variety of sources manually and using statistical software, accompanying it with a range of data visualisations
- select, use, and evaluate appropriate statistical models for making predictions (including regression, time-series, and classification models)
- estimate and calculate probabilities of independent, combined, and conditional events, using probability-distribution models
- conduct large-scale, technology-supported simulations to model probabilistic outcomes
- calculate, interpret, and evaluate the number of possible arrangements in a set, the expected values of an event, risk in situations, and appropriate intervals to communicate uncertainties in situations.

Understand

> *Kei hopu tōu ringa ki te aka tāepa, engari kia mau ki te aka matua.*

The world is charaterised by change and variation that we use mathematics and statistics to understand.

> *Ko te pae tawhiti whāia kia tata, ko te pae tata whakamaua kia tina.*

Mathematical and statistical logic and reasoning enable us to identify and explain relationships and to justify conclusions.

Know

The gradient of the tangent line at a maxima or minima of a function is 0 or undefined.

Tauanga | Statistics

Data can reflect and amplify bias and harm at every stage in its lifecycle, including its creation, collection, access, analysis, interpretation, use, and re-use.

We have a responsibility to gather and use data to strengthen kotahitanga (collective benefit) and social cohesion, especially for those who have consented to the use of their data.

Everyone involved in data-based investigation and its reporting has their own preconceptions and biases. We have to guard against harmful effects from these.

Algorithmic predictive-models developed from data may have built-in biases.

A prediction from a model has a distribution, which will change when the conditioning or predictor variables are changed.

For statistical inference, data is sometimes obtained using random sampling, to enable and justify sample-to-population inferences. Sometimes experiments are used to justify cause-and-effect inferences.

Simulation-based methods such as randomisation tests can be used to assess the strength of evidence for the existence of effects.

Tūponotanga | Probability

Probabilities can be estimated from gathered (empirical) data or from theoretical models; both approaches make assumptions that might not be valid.

Expected values can be calculated for discrete random variables.

Generating data from a probability model through simulation can demonstrate what outcomes are likely or unlikely under certain conditions, as well as the variability of the outcomes.

Probabilities from theoretical models and experimental estimates are approximations of the true probabilities, which are never known exactly.

Do

Te whakatauwhānui i ngā kitenga pāngarau me ngā kitenga tauanga | Generalising mathematical and statistical findings

I can:

- form generalisations from patterns observed when performing operations on variables with exponents
- identify patterns in equations, including those arising from a polynomial, reciprocal, rational-power, trigonometric, exponential, or logarithmic function, the rate of change of the function, and the area under its curve that allows generalisations
- generalise methods for solving whole classes of problems
- explore and prove conjectures about functions – the nature of their graph, their rate of change, and the area under their curve
- make formal sample-to-population inferences by using a resampling method to construct confidence intervals for means, medians, proportions, and their differences
- make experiment-to-causation inferences involving a comparison of two independent groups
- make and critique claims for poll-based reports by taking into account the informal margin of error for proportions and their differences and considering possible sources of bias
- use informal tests to determine how well a probability-distribution model fits a set of observations (i.e., goodness-of-fit)
- predict and explain effects caused by changing the parameters of probability distributions.

Te whakamārama, te parahau me te arotake i ngā kitenga pāngarau me ngā kitenga tauanga | Explaining, justifying, and evaluating mathematical and statistical findings

I can:

- evaluate findings and analyse situations by using counterexamples, breaking them into cases if necessary
- compare the plausibility of arguments, identifying flawed logic or reasoning and explaining why it is flawed
- critique the reasoning of others and interrogate their findings to clarify or improve their arguments
- explain solutions that involve square roots of negative numbers
- geometrically interpret the solutions systems of linear equations in three-dimensional space
- critique the language and statistical information used by others in claims, and recognise when statistical information is embedded in text-based communications
- say whether or not a data visualisation is trying to convince us of something and, if so, whether misleading strategies are being used
- use critical questions to critique a wide range of data-based information from a variety of sources, including the media.

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