

What's new/changed in Mathematics?

Mathematics is about developing students' understanding of mathematics. This means that they have:

- conceptual understanding: comprehension of mathematical concepts, operations and relations;
- procedural fluency: skill in carrying out procedures flexibly, accurately, efficiently, and appropriately;
- strategic competence: the ability to formulate, represent, and solve mathematical problems;
- adaptive reasoning: ability for logical thought, reflection, explanation, and justification;
- productive disposition: habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's own efficacy.

These characteristics are more than just mastery of skills and concepts. See Effective Pedagogy in Mathematics/Pangarau Best Evidence Synthesis Iteration (page 7).

See <http://www.educationcounts.govt.nz/publications/series/2515/5951>]

- The header statement "In a range of meaningful contexts, students will be engaged in thinking mathematically and statistically. They will solve problems and model situations that require them to:" is key to interpreting the achievement objectives. A clear focus is that **students will be doing the thinking**, rather than following the thinking or procedures as demonstrated by the teacher.
- *A feature of the progression of the achievement objectives is that numeric understanding is intended in the level below the algebraic generalisations of the same concept or process. For example, NA6-2 extending powers to include integers and powers precedes doing this algebraically as in M7-6.
- The venn diagram gives a time allocation at Level 6 only. This guideline indicates that the three strands, Number and Algebra, Geometry and Measurement and Statistics should all be allocated approximately the same amount of teaching and learning time. Number and Algebra would have slightly more time.
- Use of appropriate technology is expected throughout all the achievement objectives.

Level 6

Number strategies and knowledge

NA6-1 Apply direct and inverse relationships with linear proportions.

What is new/changed?

- Using a range of different methods in solving rate, ratio and percentage problems, not just the algorithmic numerical method.
- Basic operations on fractions is covered in NA5-3 understand operations on fractions, decimals, percentages, and integers.

NA6-2 Extend powers to include integers and fractions.

What is new/changed?

- Understanding of these concepts provides a solid grounding for the algebraic understanding in M7-6 manipulate rational, exponential, and logarithmic algebraic expressions.
- See note * above.

NA6-3 Apply everyday compounding rates.

What is new/changed?

- This was previously located in the measurement strand.

NA6-4 Find optimal solutions, using numerical approaches.

What is new/changed?

- These are the numeric concepts that underpin the concepts in M7-5 choose appropriate networks to find optimal solutions.
- See note * above.

Equations and expressions

NA6-5 Form and solve linear equations and inequations, quadratic and simple exponential equations, and simultaneous equations with two unknowns.

What is new/changed?

- Solving simple exponential equations is new.

- Simple quadratics are introduced at level 5 (NA5-7).

Patterns and relationships

NA6-6 Generalise the properties of operations with rational numbers, including the properties of exponents.

What is new/changed?

- Generalising includes factorising, expanding, and simplifying expressions involving rational numbers and exponents.

NA6-7 Relate graphs, tables, and equations to linear, quadratic, and simple exponential relationships found in number and spatial patterns.

What is new/changed?

- This achievement objective implies a use of technology.
- It is not about graph sketching skills but has more of a focus on linking representations (patterns, tables, equations and graphs) and interpreting features of graphs in context.

NA6-8 Relate rate of change to the gradient of a graph.

What is new/changed?

- This was previously located in the measurement strand.

Measurement

GM6-1 Measure at a level of precision appropriate to the task.

What is new/changed?

- This was previously located in the number strand.

GM6-2 Apply the relationships between units in the metric system, including the units for measuring different attributes and derived measures.

What is new/changed?

- This is a new objective.

GM6-3 Calculate volumes, including prisms, pyramids, cones, and spheres, using formulae.

What is new/changed?

- "Calculate volumes" has moved from level 5.

Shape

GM6-4 Deduce and apply the angle properties related to circles.

What is new/changed?

- This is a new objective, though the detail was in the suggested learning experiences in the old curriculum.
- Deduce could mean finding properties using technology as well as geometrically or algebraically.

Level 7

Patterns and relationships

M7-1 Apply co-ordinate geometry techniques to points and lines.

What is new/changed?

- This was previously located in the geometry strand.

M7-2 Display the graphs of linear and non-linear functions and connect the structure of the functions with their graphs.

What is new/changed?

- Display could include the use of technology.
- As with level 6 the focus is on connecting representations.

M7-4 Apply trigonometric relationships, including the sine and cosine rules, in two and three dimensions.

What is new/changed?

- This was previously located in the geometry strand at level 6.

M7-5 Choose appropriate networks to find optimal solutions.

What is new/changed?

- This was previously located in the geometry strand.

Calculus

M7-10 Apply differentiation and anti-differentiation techniques to polynomials.

What is new/changed?

- This does not include finding definite integrals or areas.

Level 8

Patterns and relationships

What is new/changed?

- There are no specific sequences and series objectives at this level.

M8-5 Develop network diagrams to find optimal solutions, including critical paths.

What is new/changed?

- This is a new objective that builds on M7-5 and includes critical paths.

Equations and expressions

What is new/changed?

- Binomial expansions are not required.

M8-7 Form and use trigonometric, polynomial, and other non-linear equations.

What is new/changed?

- Bisection and Newton-Raphson methods are not required. Use of Remainder and Factor theorems are included.

M8-11 Choose and apply a variety of differentiation, integration, and anti-differentiation techniques to functions and relations, using both analytical and numerical methods.

What is new/changed?

- This does not include related rates of change, integration of relations nor volume of revolution.

What is new/changed in Statistics?

Overview

Statistical investigation

- **They will be using the whole statistical enquiry cycle and the stages of the cycle are transparent in what they do. That is the Problem, the Plan, the Data, the Analysis and the Conclusion.**
- The expectation is that students will become data detectives and they will use exploratory data analysis.
- Emphasis is changing from constructing plots to reasoning with plots (use of technology to create plots).
- There is an expectation of using technology to create plots and other data displays.
- There is an emphasis on building conceptual understanding across the levels, particularly students' inferential understanding.
- The students will be doing more reasoning and writing about the plots and statistics, rather than making lots of calculations and drawing plots.
- Statistics is moving from being a mathematics-centred series of techniques to using computers and simulations and to reasoning with and about data.
- Context plays an important role in the statistics classroom, with the focus moving from students' general knowledge we expect them to know to students searching out relevant contextual knowledge.
- Use of two-way tables, dot and box plots, histograms, and scatterplots is an expectation at all levels.
- The mean and median are properties distributions rather than stand alone statistics. These need to be connected with the distribution.

Statistical literacy

- Students will have to be working with text and associated graphs.
- They will need to comprehend what is presented.
- They will need to be able to critique and interpret the statistical ideas that are embedded in the text.
- They will need to be able to ask questions to seek clarification and further understanding.

Probability

- Students will need to understand the underlying concepts of probability and not just use the rules.
- There is an emphasis on probability distributions, seeing the whole rather than just calculating the probability of a single event.
- Understanding the difference between theoretical and experimental probability distributions and the connections between them.

By Achievement Objective

Level 6

Statistical investigation

S6-1 Plan and conduct investigations using the statistical enquiry cycle:

- A justifying the variables and measures used
- B managing sources of variation, including through the use of random sampling
- C identifying and communicating features in context (trends, relationships between variables, and differences within and between distributions), using multiple displays
- D making informal inferences about populations from sample data
- E justifying findings, using displays and measures.

What is new?

- Justifying variables and measures used.
- Looking at the different sources of variation, for example, measurement variation.
- Random sampling.
- Sampling variation.
- Informal inferences using informal decision criteria as evidence for making a claim which is based on an understanding of sampling variation.
- Alternative explanations for observed patterns in the data.
- Contextual knowledge plays an important role in the entire statistical enquiry cycle.

Statistical literacy

S6-2 Evaluate statistical reports in the media by relating the displays, statistics, processes, and probabilities used to the claims made.

What is new?

- Evaluation of statistical reports in the media.

Probability

S6-3 Investigate situations that involve elements of chance:

- A comparing discrete theoretical distributions and experimental distributions, appreciating the role of sample size
- B calculating probabilities in discrete situations.

What is new?

- Appreciating the role of sample size, the connection between sample size and variation.
- Laying down foundations for the binomial distribution (discrete situations).

Statistical investigation

S7-1 Carry out investigations of phenomena, using the statistical enquiry cycle:

- A conducting surveys that require random sampling techniques, conducting experiments, and using existing data sets
- B evaluating the choice of measures for variables and the sampling and data collection methods used
- C using relevant contextual knowledge, exploratory data analysis, and statistical inference.

S7-2 Make inferences from surveys and experiments:

- A making informal predictions, interpolations, and extrapolations
- B using sample statistics to make point estimates of population parameters
- C recognising the effect of sample size on the variability of an estimate.

What is new?

- Conducting experiments.
- Use of exploratory data analysis.
- Statistical inference.
- Informal confidence intervals for population medians.
- The effect of sample size on the variability of an estimate.
- Using relevant contextual knowledge (given).

Statistical literacy

S7-3 Evaluate statistically based reports:

- A interpreting risk and relative risk
- B identifying sampling and possible non-sampling errors in surveys, including polls.

What is new?

- Risk.
- Identifying non-sampling errors in surveys, including polls.

Probability

S7-4 Investigate situations that involve elements of chance:

- A comparing theoretical continuous distributions, such as the normal distribution, with experimental distributions
- B calculating probabilities, using such tools as two-way tables, tree diagrams, simulations, and technology.

What is new?

- This is where students should first meet probability trees as a calculation tool.
- Use of two-way tables to solve probability problems.
- Simulations remain an important focus.
- Presenting the normal distribution as a useful model for explaining and exploring many situations.

Level 8

Statistical investigation

S8-1 Carry out investigations of phenomena, using the statistical enquiry cycle:

- A conducting experiments using experimental design principles, conducting surveys, and using existing data sets
- B finding, using, and assessing appropriate models (including linear regression for bivariate data and additive models for time-series data), seeking explanations, and making predictions
- C using informed contextual knowledge, exploratory data analysis, and statistical inference
- D communicating findings and evaluating all stages of the cycle.

- S8-2 Make inferences from surveys and experiments:
A determining estimates and confidence intervals for means, proportions, and differences, recognising the relevance of the central limit theorem
B using methods such as resampling or randomisation to assess the strength of evidence.

What is new?

- Experimental design.
- Using informed contextual knowledge (seek themselves).
- Use of exploratory data analysis.
- Communicating findings and evaluating all stages of the cycle.
- Difference of medians.
- Resampling and randomisation methods will be used to generate confidence intervals and to assess the strength of evidence; this means that the central limit theorem is de-emphasised as a basis for confidence intervals. Rather the focus is on the logic behind inference. Computer use for these methods is essential.

Statistical literacy

S8-3 Evaluate a wide range of statistically based reports, including surveys and polls, experiments, and observational studies:

- A critiquing causal-relationship claims
B interpreting margins of error.

What is new?

- Critiquing causal-relationship claims.
- Interpreting margins of error.
- Use of a wide range of statistically based reports.

Probability

S8-4 Investigate situations that involve elements of chance:

- A calculating probabilities of independent, combined, and conditional events
B calculating and interpreting expected values and standard deviations of discrete random variables
C applying distributions such as the Poisson, binomial, and normal.

What is new?

- Distinguishing between deterministic and probabilistic models.
- Demonstrating understanding of the relationship between true probability (unknown and unique to the situation), model estimates (theoretical probability) and experimental estimates.
- Making a reasonable estimate of mean and standard deviation from a plot of the distribution of a discrete random variable.
Solving and interpreting solutions of problems involving calculation of mean, variance and standard deviation from a discrete probability distribution.
- Demonstrating understanding of the link between probabilities and areas under density functions for continuous outcomes (eg normal, triangular, uniform but nothing requiring integration).
- Demonstrating understanding of the way a probability distribution changes as the parameter values change.
- Using a distribution to estimate and calculate probabilities, including by simulation.