#### NZC Statistics Levels 1 - 6

| Level | Statistical Investigation | Statistical Literacy | Probability |
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| 1 | Conduct investigations using the statistical enquiry cycle:  •posing and answering questions  •gathering, sorting and counting, and displaying category data •discussing the results. | Interpret statements made by others from statistical investigations and probability activities. | Investigate situations that involve elements of chance, acknowledging and anticipating possible outcomes. |
| 2 | Conduct investigations using the statistical enquiry cycle:  •posing and answering questions  •gathering, sorting, and displaying category and whole-number data  • communicating findings based on the data. | Compare statements with the features of simple data displays from statistical investigations or probability activities undertaken by others. | Investigate simple situations that involve elements of chance, recognising equal and different likelihoods and acknowledging uncertainty. |
| 3 | Conduct investigations using the statistical enquiry cycle:  • gathering, sorting, and displaying multivariate category and whole number data and simple time-series data to answer questions • identifying patterns and trends in context, within and between data sets • communicating findings, using data displays. | Evaluate the effectiveness of different displays in representing the findings of a statistical investigation or probability activity undertaken by others. | Investigate simple situations that involve elements of chance by comparing experimental results with expectations from models of all the outcomes, acknowledging that samples vary. |
| 4 | Plan and conduct investigations using the statistical enquiry cycle:  • determining appropriate variables and data collection methods  •gathering, sorting, and displaying multivariate category, measurement, and time-series data to detect patterns, variations, relationships, and trends •comparing distributions visually  •communicating findings, using appropriate displays. | Evaluate statements made by others about the findings of statistical investigations and probability activities. | Investigate situations that involve elements of chance by comparing experimental distributions with expectations from models of the possible outcomes, acknowledging variation and independence.  Use simple fractions and percentages to describe probabilities. |
| 5 | Plan and conduct surveys and experiments using the statistical enquiry cycle:  •determining appropriate variables and measures •considering sources of variation  •gathering and cleaning data  •using multiple displays, and re-categorising data to find patterns, variations, relationships, and trends in multivariate data sets  •comparing sample distributions visually, using measures of centre, spread, and proportion  •presenting a report of findings. | Evaluate statistical investigations or probability activities undertaken by others, including data collection methods, choice of measures, and validity of findings. | Compare and describe the variation between theoretical and experimental distributions in situations that involve elements of chance.  Calculate probabilities, using fractions, percentages, and ratios. |
| 6 | Plan and conduct investigations using the statistical enquiry cycle:  •justifying the variables and measures used;  •managing sources of variation, including through the use of random sampling;  •identifying and communicating features in context (trends, relationships between variables, and differences within and between distributions), using multiple displays;  •making informal inferences about populations from sample data;  •justifying findings, using displays and measures. | Evaluate statistical reports in the media by relating the displays, statistics, processes, and probabilities used to the claims made. | Investigate situations that involve elements of chance:  •comparing discrete theoretical distributions and experimental distributions, appreciating the role of sample size;  •calculating probabilities in discrete situations. |

Key Ideas Statistics L 1 – 6 [www.nzmaths.co.nz](http://www.nzmaths.co.nz)

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| 2 | Conduct investigations using the statistical enquiry cycle:  •posing and answering questions  •gathering, sorting, and displaying category and whole-number data  • communicating findings based on the data. | Compare statements with the features of simple data displays from statistical investigations or probability activities undertaken by others. | Investigate simple situations that involve elements of chance, recognising equal and different likelihoods and acknowledging uncertainty. |
| 3 | The key idea of statistical investigations at level 3 is telling the **class story** with supporting evidence.  Students are building on the ideas from level two and their understanding of different aspects of the PPDAC (Problem, Plan, Data, Analysis, Conclusion) cycle. Key transitions at this level include posing summary investigative questions, and collecting and displaying multivariate and time series data.  Summary or time series investigative questions will be posed and explored. Summary investigative questions need to be about the group of interest and have an aggregate focus. For example, what are typical numbers of children in a family for students in our class? What types of fruit do students in our class like?  Data displays build on the frequency plots from level two and can be formalised into dot plots and bar graphs. Students should be encouraged to show a second variable, for example, by using colour. They may like to look at boys and girls fruit preferences.  Students will be making summary statements, for example, the most common number of children in a family for our class is three, nine students have three children in their family (**read the data**), or most students (16 students out of the 27 in our class) have between two and four children in their family (**read between the data**).   Teachers should be encouraging students to **read beyond the data** by asking questions such as: “If a new student joined our class, how many children do you think would be in their family?” | The key idea of statistical literacy at level 3 is being a savvy consumer of data.  At level three is students are using their knowledge about different types of displays or different ways of representing data to decide if the one used is effective in presenting the main findings from a statistical investigation or a probability activity. They are building on the key idea from statistical literacy level 2 where they are starting to reason from data.  Students are deciding if the “display” is suitable for the intended audience, can people clearly understand what the “display” is trying to say? Displays include things such as tables, graphs, tree diagrams, calculations, and probabilities. They are exploring computer/web-based data visualisations including static and dynamic images. | The key idea of probability at level 3 is quantifying one-stage chance situations by deriving probabilities and probability distributions from theoretical models and/or estimating probabilities and probability distributions from experiments.   At level 3 students are beginning to explore one-stage chance situations, for example tossing a drawing pin, throwing a die from a board game, tossing or spinning a coin, rolling a pencil, or tossing a “pass the pigs” pig. They are listing possible outcomes for situations. Students are recording their results and plotting frequencies of outcomes. Students are comparing their experimental results with others in the class, acknowledging that results may vary. Students are recognising that in some chance situations outcomes are not equally likely, for example tossing a pig or drawing pin.  Students are learning about the three different types of chance situations which can arise:   1. **Good model:** An example of this is the standard theoretical model for a fair coin toss where heads and tails are equally likely with probability ½ each. Repeated tosses of a fair coin can be used to estimate the probabilities of heads and tails. For a fair coin we would expect these estimates to be close to the theoretical model probabilities. 2. **No model:** In this situation there is no obvious theoretical model, for example, a drawing pin toss. Here we can only estimate the probabilities and probability distributions via experiment. (These estimates can be used as a basis for building a theoretical model.) 3. **Poor model:** In some situations, however, such as spinning a coin, we might think that the obvious theoretical model was equally likely outcomes for heads and tails but estimates of the outcome probabilities from sufficiently large experiments will show that this is a surprisingly poor model. (Try it! Another example is rolling a pencil.) There is now a need to find a better model using the estimates from the experiments.   Link to statistical investigations: Students are exploring outcomes for single categorical variables in statistical investigations from a probabilistic perspective. |
| 4 | The key idea of statistical investigations at level 4 is telling the **class story in detail** with supporting evidence. Students are building on the ideas from level three about different aspects of the PPDAC (Problem, Plan, Data, Analysis, Conclusion) cycle. Key transitions at this level include posing comparison and relationship investigative questions, planning investigations including data generation, collecting and displaying measurement data, and comparing distributions visually. Comparison and relationship investigative questions will be posed and explored. Comparison investigative questions need to be about the group of interest and have an aggregate focus. For example, do the boys in our class tend to be taller than the girls in our class? Is there a relationship between armspan length and height for the students in our class? Students should be planning to collect their own data for the investigative question they have posed. This includes determining appropriate variables and data collection methods. For example, they need to realise that to answer the first question they will need to measure student’s heights. Along with this they will need to think about what units to measure with and whether students should leave their shoes on or not, and who will take the measures. This is data generation.  Students should be using dot plots and scatter plots to display data. When comparing dot plot distributions visually they can identify the middle group by circling it and reason about the placement of the middle groups (shift) relative to one another. They can compare (approximate) centres and the variation of the data in the middle groups. Students can use tools such as hat plots and any statistical software that is available. For scatterplots students should be looking at features such as the trend of the data points and how close the points are to the trend. Adding a third variable, for example gender, by using colour allows for further exploration.  Students should be writing statistically sound statements about what their displays show. The starter “I notice...” is a useful way to encourage students to write about what their displays show. In addition students should be encouraged to write “I wonder...” statements for further investigation. | The key idea of statistical literacy at level 4 is thinking beyond the data presented.  At level four the focus of the evaluation expands from “displays” (key idea at level 3) to statements made by others about their findings. They should be looking for statistically sound statements based on the data presented in the findings and suggesting alternative correct wording when this isn’t the case.  Students should be asking “what if” and “why” questions about other students’ findings.   Students should be thinking whether there are alternative findings from the data, or if there are other relevant variables that could be considered other than what was reported in the findings of other students.. | The key idea of probability at level 4 is estimating probabilities and probability distributions from experiments and deriving probabilities and probability distributions from theoretical models for two-stage chance situations. At level 4 students are experimenting with two-stage chance situations, for example tossing two coins, dice, pigs, drawing pins, a coin and a die. Students are systematically listing all possible outcomes including using tools such as two way tables. Students are recording their results and plotting frequencies of outcomes. Students are recognising that in some chance situations outcomes are not equally likely, for example getting two heads or a head and a tail. Students are comparing their experimental results with others in the class. They should also where possible compare estimated probabilities and probability distributions from experiments with theoretical model probabilities and probability distributions.  Starting with a one-stage chance situation (e.g., tossing one coin) students need to recognise that estimates of probabilities from experiments should be based on a very large number of trials. Technology is a useful tool for large numbers of trials. In addition students should be exploring the idea of independence in probability using a one-stage chance situation, for example tossing one coin or one pig. In this setting independence refers to sequences of trials where the outcome of one trial has no impact on the next trial. For example, five tosses of a fair coin have come up HHHHH, the probability of getting a head on the next toss is still ½. The three different types of chance situations described in [level three](http://www.nzmaths.co.nz/node/9220) need to be reinforced at this and other levels. Link to statistical investigations: Students are exploring outcomes for two simple categorical variables in statistical investigations from a probabilistic perspective. For example, using gender and tongue roll or not, what is the probability that a randomly selected student is a boy and can roll his tongue? |
| 5 | The key idea of statistical investigations at level 5 is telling a **story about the wider universe** with supporting evidence.  Students are building on the ideas from level four about different aspects of the PPDAC (Problem, Plan, Data, Analysis, Conclusion) cycle. The key transition at this level is the acknowledgement that samples can be used to answer questions about populations.  Students will be posing investigative questions about populations and using samples to answer these.  Students need to realise that the data collected may have to be cleaned. To help with this they should be familiar with the survey questions posed, who the data was collected from and how the data was collected. Once data is identified as needing cleaning, strategies on how to do this should be discussed, for example, whether the value removed, or “cleaned”.   Students may need to recategorise data into broader categories or smaller categories depending on the question they are trying to answer. They will be looking at patterns and trends in displays and using these to answer their investigative question. Thinking routines such as: “What information can you get from this plot?” and “What evidence do you have for saying that?” will be helpful for students. Students will be starting to use informal methods to make comparisons between sample distributions using box plots and growing their reasoning about sampling variability, shape, spread, unusual and interesting features, and making a call. See CensusAtSchool [2009 Teachers Day](http://www.censusatschool.org.nz/2009/informal-inference/). | The key idea of statistical literacy at level 5 is detecting flaws in the investigations of others.  At level 5 the focus of the evaluation expands from “displays” (key idea at level 3) and findings (key idea at level 4) to the whole statistical or probability investigation including data collection methods, choice of measures and validity of findings of others.   Students should be focusing on the planning and data collection phases of statistical and probability investigations. They should be looking at the quality of data, how the measures were defined, how the data was collected, and whether the findings are valid based on the data collection method and the measures used.   By this level students will have evaluated all phases of the PPDAC cycle and will use this knowledge at higher levels when they look at reports from specific fields. | The key idea of probability at level 5 is estimating probabilities and probability distributions from experiments and deriving probabilities and probability distributions from theoretical models for two- and three-stage chance situations and recognising the connections between experimental estimates, theoretical model probabilities and true probabilities.  At level 5 students are exploring two- and three-stage chance situations, for example using spinners, drawing marbles out of a bag (with replacement) tossing three dice, or rock, scissors and paper. More complex chance situations can be explored, for example two spinners with different colour combinations on them, or two bags of marbles with different numbers of each colour in them, or a mixture such as a bag of marbles and a spinner. Problems include ones like “Is the game fair?”  Students are systematically listing all possible outcomes using tree diagrams and other relevant tools such as two way tables. Students are recording their results and plotting frequencies of outcomes. Students are aware that in some chance situations outcomes are not equally likely.  Students are where possible comparing experimental estimates with theoretical model probabilities. Students need to recognise that theoretical model probabilities and experimental estimates of probabilities are approximations of the true probabilities which are never known. All probabilities lie in the range 0-1.  The three different types of chance situations described in [level three](http://www.nzmaths.co.nz/node/9220) need to be reinforced at this and other levels.  Link to statistical investigations: Students are exploring outcomes for two categorical variables in statistical investigations from a probabilistic perspective.. |
| 6 | The key idea of statistical investigations at level 6 is telling a story about a wider universe, taking **variation and uncertainty** into account, with supporting evidence.  Students are consolidating and refining their ideas about different aspects of the PPDAC (Problem, Plan, Data, Analysis, Conclusion) cycle. Key transitions at this level include the integration of statistical and contextual knowledge to answer the investigative questions and making informal inferences about populations from samples.  Students should be justifying variables and measures used in the data collection phase and thinking about the possible underlying population distributions for the variables of interest.   In the analysis phase students should be using multiple displays to show different features of the sample distributions. Key features of the sample distributions should be discussed; integrating statistical and contextual information. Students will confidently be using informal methods to make comparisons about populations using sample distributions including reasoning about shift, overlap, sampling variability and sample size.   Students should be reflecting on their findings and how this fits with real world experiences. | The key idea of statistical literacy at level 6 is being a data savvy citizen.  At level six students are using the interpretation and evaluation skills developed through levels 3-5 and applying these in evaluating media type reports. They are using the level 6 [critical questions](http://nzstatsedn.wikispaces.com/file/view/wrtingframestatlitL6.doc) to evaluate the media report reflecting all aspects of the PPDAC cycle.  Media type reports includes things such as: advertisements, magazine articles, misleading graphs in the media, school newspaper articles, travel brochures. | The key idea of probability at level 6 is exploring chance situations involving discrete random variables. At level 6 students are exploring discrete chance situations. For example, students could explore the distribution of the number of girls in a five child family. The probability of having a girl is ½. The possible outcomes are 0, 1, 2, 3, 4, or 5 girls. They could derive theoretical model probabilities by systematically listing all the different ways they could get 0, 1, 2, 3, 4, or 5 girls, and/or they could estimate probabilities via experiment using technology or other means. Alternatively they could explore the distribution of the number of successful hoops in three free throws in basketball. In this situation they would need to physically shoot the hoops and estimate the probabilities. This is laying the foundations for the binomial distribution in level 8.  Another example which can be explored both ways is the situation where an imaginary two-eyed being has a combination of red, green and yellow eyes. The colour for each eye is equally likely to be red, green or yellow and the colour of one eye is independent of the other eye. Possible explorations include looking at probabilities (theoretical model and/or estimated via experiment) of the outcomes for 0, 1, or 2 red eyes (binomial) and/or probabilities of given combinations of eye colour, for example yellow/green eyes. Students need to appreciate the role sample size plays in estimating probabilities via experiment. Students are recording their results and plotting frequencies of outcomes and starting to get a sense of probability distributions. Students are aware that in some chance situations outcomes are not equally likely. The three different types of chance situations described in [level three](http://www.nzmaths.co.nz/node/9220) need to be reinforced at this and other levels. Link to statistical investigations: Students are exploring outcomes for categorical variables in statistical investigations from a probabilistic perspective. |