Teacher Resource Bank

GCSE Statistics

Schemes of Work

- Higher Tier

aqa.org.uk

The Assessment and Qualifications Alliance (AQA) is a company limited by guarantee registered in England and Wales (company number 3644723) and a registered charity (registered charity number 1073334). Registered address: AQA, Devas Street, Manchester M15 6EX.
Dr Michael Cresswell, Director General.

44225

Introduction to the Higher Scheme of Work

The following scheme of work is a suggestion only. It has been designed by a teacher of Statistics as a possible route through the GCSE Statistics Higher Tier, though it should be noted that there are many ways to successfully deliver this course.

One of the decisions to be made when delivering Higher Tier is to what extent work more often tested at Foundation should be covered. This is entirely dependent upon the nature of the class you may be teaching. This scheme of work has tried to follow a typical scenario where crucial supporting work is covered but a certain level of knowledge has been assumed in some areas such as basic knowledge of diagrams, measures of average and probability. Much of the Foundation material in areas such as data collection methods and sampling are essential elements for the Higher Tier and should be covered in full in a Higher Tier course.

Prior to the delivery of the actual specification detailed here it would be a good idea to have a session on the Handling Data Cycle. The stages which are part of the handling Data cycle form the essence of the course suggested here.

In brief the Handling Data cycle begins with the specifying of the question which is to be investigated which will then lead to a hypothesis being set up. Then data needs to be collected to address the hypothesis. Careful consideration needs to be given to what data should be collected, how it should be collected and where it should be collected from. The next stage is to illustrate the collected data in suitable diagrams and calculate appropriate measures for this data. Finally the graphs and measures need to be interpreted in the light of the hypothesis and decisions need to be made as to whether the hypothesis is deemed to be supported or not. It is quite likely that evaluation at this stage may lead to a decision to refine the hypothesis or ask associated questions which would begin the cycle of data collection once more, hence the term cycle for this overall process.

This Scheme of Work follows the actual order of the specification for the first two stages of the Handling Data cycle. From then this particular route through the specification takes different graphs and calculations in sections by type with associated skills of analysis and interpretation inherent in each section.

Undoubtedly there are many other equally plausible ways of delivering the course.

This Scheme of Work has been divided into 10 sections.

Each section is previewed by a list of what students should generally understand after doing the section.

Following this there is a table consisting of 3 columns.

The left hand column is headed ' Specification Content' and is the full specification – not using exactly the same words as those printed, but covering all the material which is needed to successfully and fully cover the material at Higher level. This is where some decisions about prior knowledge inevitably have to be made as described earlier.

The middle column is headed 'Teaching and Learning Opportunities' and gives more depth about what would be useful to cover as well as providing some ideas as to how that coverage may be achieved in some instances.

The final column is headed 'Extension Possibilities' and gives just that where appropriate. There are also research opportunities given in this final column.

Specification Section A (3.1.1 Planning a Strategy)

In this section students need to understand:

- what a hypothesis is and how to write one
- how to compare the methods available to collect data to address the hypothesis and how that data might be collected
- what is meant by research questions and how to specify them
- issues connected to planning and collection such as time and cost restraints.

Specification Content	Teaching and Learning Opportunities	Extension Possibilities
How to write a hypothesis in such a way that it can be tested.	Look at questions that interest students, how can they be transformed into hypotheses?	The idea of hypothesis testing using the actual data values and probabilities.
What data would be needed to address a given hypothesis?	What data would be required to be able to make some judgements about the validity of the hypotheses?	
How to select an appropriate method for obtaining the data required.	What options are available to get meaningful data to address the hypotheses? Which provide the best solutions? Comparing methods of data collection.	How do public agencies collect data?
How to specify a research question possibly broken down into sub-questions.	What's the difference between a research question and the hypothesis it comes from?	
That problems can arise in identifying the population, distribution and collection of questionnaires, non-response, errors in recording answers and missing data and strategies to deal with these problems.	Follow a practical problem and predict the sources of these problems. How would they be dealt with?	Census 2011, how are collection difficulties overcome?

Specification Section B (3.1.2 Data Collection)

In this section students need to understand :

- about different types of data that exist and how it can be classified
- how data can be collected by various methods
- what a census is
- the purpose of sampling and how to use and describe different sampling methods available
- issues surrounding surveys, experiments, interviews and questionnaires
- simulation - how is this a data collection method?
- the different types of experiments, variables and groups involved.

Specification Content **3.1.2a Types of Data**	**Teaching and Learning Opportunities**	**Extension Possibilities**
Raw data. Primary and secondary data sources. Qualitative and quantitative variables. Categorical data. Discrete and continuous data. Bivariate data. Classification of data, class limits and intervals including open ended classes.	Do all data sources provide secondary data? What makes data primary data? Take an atlas or encyclopaedia and look at the data for a particular country. Which of the variables are qualitative, quantitative, discrete, continuous or bivariate? At Higher Tier this can be brief but it is important students know all data types. Transforming between labelling systems using double inequalities and other methods.	Investigate the extensive range of methods available.
3.1.2b Obtaining Data		
Counting, measuring and their levels of accuracy Design and use of efficient methods of recording data appropriate to the purpose for which it will be used.	Use of observation sheets. Use of data logging machines.	How accurate do values need to be in different situations, eg for some of the data in the National Census? Investigate the use of data logging in “car park full” signs in a city.

3.1.2c Census Data		
Obtaining information from well defined populations.	When might it be possible to capture data from an entire population?	When would a sample become a population?
Awareness of National Census	How often, what is collected and how?	Many people work on data collection for the National Census, it may be possible to find out how they work and some of the very strict rules they have to adhere to. Internet research on previous Censuses and how the Census has developed since it began in this country. Comparison with historical censuses and their use in ancient history.
3.1.2d Sampling		
Purpose of sampling.	The many practical reasons why a sample would be preferred to a census in most cases.	
Variability between samples.	What would be similar and what might be different about two samples from the same population?	
Randomness, random numbers from tables, calculators and computers.	Obtain a sample of 100 three-digit random numbers from a reliable source such as a random number table.	
Sampling from a well defined population.	What makes a population 'well defined'? Is the school population 'well-defined'?	Explain why the sampling methods which follow would not be possible to carry out if the population was not well defined.
Sample frame.	What is it? How is it defined for the school population at any given time?	What is the difference between a sample frame and the population?
Simple random sampling, the condition that all members are equally likely to be included in the sample.	Work out a simple random sample of 5 from the statistics class listing all the steps required.	What is the second condition for a genuine random sample?

3.1.2d Continued...		
Use of stratification in a sample design using no more than two sets of categories.	Meaning of stratification and the typical options available. Why is stratification carried out? How to calculate the number of the sample required from each group after stratification.	Why is the term 'stratified sampling' which is often used, an incorrect term?
The meaning and use of cluster, quota and systematic sampling.	What are the key points of these sampling methods? Where are they used?	What are the similarities between quota and convenience sampling?
Multi-stage sampling.	What are the main features of multi-stage sampling. How is multi-stage sampling used? How to use multi-stage sampling in context.	
Awareness of dangers of convenience sampling.	Consider for example the difference between people in a class who would volunteer to do things and those who wouldn't.	The pebbles experiment* which provides a better estimate of the mean weight a random or a judgement sample? * 100 numbered pebbles in a box, mean weight known.
Strengths and weaknesses of all the sampling methods.	Give reasons why in particular situations, each of the named sampling methods may be the best one to employ.	
Biased samples arising from sampling from a wrong population or non-random choice of individual elements.	Imagine only asking teachers about views on Facebook or only asking students about whether homework should be given out!	
Opinion polling.	What factors are used to select sample members for opinion polls.	Investigate nationally known organisations who poll about voting intentions for political parties. Which sampling methods and collection methods do they employ?

3.1.2e Conducting a survey/experiment		
Surveys.	The difference between a census and a survey (compare census v sample).	
Obtaining primary data by questionnaire.	Writing questionnaire questions for a subject close to the students' hearts. Careful choice of response sections especially in numerical response situations.	Internet research of questionnaires to gather examples of poor (and good) practice. Teacher could become a Panel member for YouGov (for example) to access good practice.
Opinion scales.	The two types of opinion scales and their advantages. (use them in following work on questionnaires).	Interpreting results from opinion surveys.
Use and reasons for pilot studies and pre-testing.	Why pre-test the questionnaire? Students to deliberately write a poor questionnaire and partners to correct and produce a better one.	See above
Problem of design, wording, biased questions, definitions, obtaining truthful answers. Closed and open questions.	The difference between open and closed questions and why they are both useful in questionnaires when appropriate.	Write an open question to replace a closed one from a questionnaire and vice versa. Which is more appropriate?
Obtaining data by interview. Advantages and disadvantages of interviews v written questionnaires.	In what circumstances might it be preferable to have questions read by an interviewer or have them written in front of you on paper?	Students can actually interview each other based on pre-prepared questionnaires perhaps on relatively sensitive subjects to obtain some insight into the issues that can arise. Issues surrounding telephone and on-line 'interviews'.
Random response.	Using a coin toss to protect people when divulging sensitive data or opinions [heads say 'yes' tails answer the question].	If desired could carry out this type of research amongst students on a difficult topic such as abortion.
Simulation using dice, random number tables, ICT.	3 lanes at a junction where left lane is three times as likely and right lane is twice as likely as the centre lane for an arrival. Simulate the next 100 arrivals using a dice.	Using a dice for 5 or 7 options in a simulation.

3.1.2e Continued...		
Using secondary sources. Consideration of reliability, accuracy, relevance and bias.	Need to know about Key Data, Annual Abstract of Statistics, Monthly Digest of Statistics, Social Trends, Economic Trends, internet newspapers as possible sources, bring some in – all named ones available on internet from www.statistics.gov.uk.	Set task of finding some very specific data from a publication.
Experiments - designing and obtaining data from simple statistical experiments.	An experiment does not have to be something done in a laboratory like in Science. Find some statistical experiments in everyday life.	
Obtaining data from observation or experiments (laboratory, field or natural experiments).	Need to know about these different types of experiments and the differences between them particularly with respect to the control element within.	Look at the Research Methods section of an AS or A2 Psychology or Sociology text book and you should find some practical examples of field or natural experiments and observational work.
Examples of extraneous variables, how to control them and keep them constant in experiments.	Are taller people heavier? What other variables might affect that hypothesis being tested by only looking at heights and weights? How can these variables be kept under control by the design of the experiment?	
Issues of inter-observer bias.	Search for two students who watched the same football match where one was a supporter of one team and the other either neutral or the supporter of the other team and compare accounts of some critical incidents (or set this up and ask for a written report into the game – always very interesting) Could be similarly done for a film or TV programme.	

3.1.2e Continued...		
Explanatory and response variables, identifying variables to be investigated Use of a control group, random allocation to control and experimental groups.	Meaning of these words as well as dependent and independent.	Reference to a sociology or psychology text book would again be of interest here.
Use of a control group, random allocation to control and experimental groups.	Importance in testing new drugs or medical procedures - why?	Research the word 'placebo'. What is one and what is its relevance to this part of the specification?

Specification Section C (most parts of 3.1.3)

In this section students need to understand :

- how to design and use classes to make data collection and analysis more manageable
- how to draw and interpret basic graphs designed for different types of data.

Specification Content **3.1.3a Tabulation**	**Teaching and Learning Opportunities**	**Extension Possibilities**
Knowing how to deal with classes or groups for numerical data including open ended classes.	Probably covered in 3.1.2a but ensure students can deal with situations such as 3 – 5, 6 – 8 which are effectively 2.5 – 5.5 and 5.5 – 8.5 etc for continuous data.	
Simplifying tables by combining categories and reducing the number of sig figs. Effects on readability and trend spotting, loss of detail.	Transforming from a frequency table without classes to one with classes – the benefits and drawbacks of doing this. Need to understand that the wider the groups the more detail is lost. The fewer figures are used the more detail is lost.	Design some data which can be made to look very different depending upon how it is summarised in a table (eg, values grouped in 10s with many towards top end of classes so if classes moved values move).
Effect of unsuitable group size in tabulation.	How many classes should there be in a grouped frequency table?	
Reading and interpreting data presented in tabular form.	Partially covered in section on secondary sources.	
Design of tables to summarise data effectively. Design and use of appropriate two-way tables.	How to draw own two – way table from information given and how to interpret already given tables.	

3.1.3a Continued...		
Graphs for Qualitative Data		
How to draw and interpret: • pie charts • proportional pie charts.	Practice for each type. Critical issues for each diagram such as keys. Interpreting these diagrams when drawn. Why use different radii for proportional pie charts? More basic methods of data display should not be neglected such as the types of bar chart and dot plots (as the latter are probably new to all candidates).	
Graphs for Quantitative Discrete Data		
How to draw and interpret • vertical line diagrams	Practice and critical issues. Interpreting these diagrams when drawn.	Which of the diagrams listed for Qualitative diagrams can, with care, be used for quantitative data too?
Graphs for Quantitative Continuous Data		
How to draw and interpret • frequency polygons • populations pyramids • histograms with equal class intervals • histograms with unequal class intervals.	Practice and critical issues. Knowledge of frequency density for histograms, plus other issues such as using histograms to estimate measures. Interpreting these diagrams when drawn.	
Other Basic Graphical forms		
How to draw and interpret • stem and leaf diagrams.	Practice and critical issues. Interpreting these diagrams when drawn. Including back to back stem and leaf.	

Specification Section D (Parts of 3.1.4)

In this section students need to understand:

- the basic measures of average, how to calculate, use and interpret them
- the basic measures of spread, how to calculate, use and interpret them
- the types of skew, how to calculate Pearson's measure of skewness and interpret values thereof
- the calculation, use and interpretation of standardised scores.

Specification Content	Teaching and Learning Opportunities	Extension Possibilities
Measures of Average		
Brief resume of basic measures of average. Geometric mean.	Uses of geometric means in averaging out interest rates.	Check that the average increase in a percentage over years is indeed the geometric rather than the arithmetic mean for a set of consecutive rises.
How to calculate and interpret the measures of average for discrete frequency distributions.	Practice and critical issues. Interpreting these measures when calculated. Use of extra columns to help calculate mean. Identify median and mode through understanding of the table. Use of sigma notation to aid calculation and understanding.	
How to find estimates of mean and median and the modal group for grouped frequency distributions	Practice and critical issues. Interpreting these measures when calculated. Understanding why these values will be estimates and then showing the methods for the mean and median of a grouped frequency distribution – including checking procedures to guard against errors.	Take a sample of raw data. Find the exact mean. Produce a grouped frequency distribution and find the estimated mean. Look and try to account for any differences between these two values.
Change of origin for the mean and effect of linear transformations.	Knowing that adding a value to all the data increases the mean by that amount and similar results.	Try an algebraic approach to adding and subtracting values to a data set to obtain general results.

Measures of Average continued...		
The advantages and disadvantages of the various measures of average.	Issues such as type, nature of data, presence of outliers and need to take all values into account in judging the worth of a particular measure of average.	Invent 3 sets of data which in each case are best represented by the mean, the mode and the median. Explain why this is the case.
Measures of Spread		
How to calculate and interpret the range. How to calculate and interpret quartiles and IQR for discrete data. Brief mention of interdecile and interpercentile ranges (more consideration with cf graphs). Standard deviation and variance and the use of sigma notation in their calculation. The advantages and disadvantages of the different measures of spread. Types of distributions' shapes - symmetrical, positive skew and negative skew. Knowledge of the Normal distribution and its features.	Practice and critical issues. Interpreting this measure when calculated. Using calculation methods at this stage. Issues such as type, nature of data, presence of outliers and need to take all values into account in judging the worth of a particular measure of spread. Calculating the measures of sd and variance using the summary statistics only is required. When might the range be an acceptable measure of spread? Why can the interdecile range be more valuable than the interquartile range? Suggest a series of curves showing the types of skew in order to show the nature of the data in a skewed or symmetrical distribution. Use diagrams from suggestion above. Key facts about the Normal distribution – 95% within just under 2 standard deviations and virtually all within 3 standard deviations.	Invent 2 sets of data which in each case are best represented by the range and the interquartile range. For very able students show them an algebraic argument for the equality of the two main formulae for standard deviation. Links with standardised scores.

Measures of Spread continued...		
How to compare distributions based on measures of location, spread and skew.	Using mean and standard deviation or median and interquartile range (or interdecile range) all depending upon the appropriateness of the measures.	
Basic methods of calculating skew.	The meaning of particular values of skew and the use of Pearson's measure of skew.	
Standardised scores as a method of comparing distributions.	Knowing how to calculate, use and interpret standardised scores referencing the Normal distribution.	

Specification Section E Cumulative Frequency (parts of 3.1.3)

In this section students need to understand:

- how cumulative frequencies are calculated and used to find simple measures
- how cumulative frequencies are put into a diagram and then used and interpreted
- differences in the display of cumulative frequency for discrete and continuous data
- box and whisker plots and their use and interpretation
- calculation and display of outliers.

Specification Content	Teaching and Learning Opportunities	Extension Possibilities
Cumulative Frequency		
The meaning of cumulative frequencies and how to calculate them.	Explain the method of cumulative frequency using efficient methods with the checking procedure for the total.	
How to display continuous or grouped data on a cumulative frequency curve or polygon and interpret these diagrams.	Why are the points plotted at the top end of the class interval?	
How to display discrete data in a cumulative frequency step polygon.	Understanding why this diagram has steps rather than a continuous upward path.	
How to use cumulative frequency diagrams to find estimates of the median, quartiles, IQR, deciles, interdecile range and percentiles.	How are the median and the quartiles estimated and why they are estimates?	Comparison of estimates of grouped data quartiles and median obtained from a cumulative frequency diagram with the actual values from the original raw data.
How to draw and interpret a box and whisker plot including the correct display of outliers.	What are the 5 important measures which are used in a box and whisker plot and how are the plots interpreted in terms of skew. Emphasis on good presentation and scaling to enable proper comparison should there be more than one. Identifying outliers using the Interquartile range and displaying them accurately in a box and whisker plot.	Obtain the measures from already drawn box and whisker plots. Other methods of determining outliers such as outside 2 or 3 standard deviations from the mean (why 2 or 3 used?).

Specification Section F Scatter Diagrams (parts of 3.1.3 and 3.1.4)

In this section students need to understand that:

- bivariate data should be shown on a scatter diagram
- correlation of differing types and strengths can exist but that doesn't necessarily mean one thing causes the other
- correlation can be measured and calculated using Spearman's Rank Correlation Coefficient
- correlation can also be measured by using the Product Moment correlation coefficient
- interpreting these measures of correlation and their differences
- lines of best fit can be drawn and used to estimate the value of one variable given the other and when this is and isn't appropriate
- calculating and drawing the equation of a line of best fit
- awareness of non linear data types.

Specification Content	Teaching and Learning Opportunities	Extension Possibilities
Scatter diagrams		
How to draw a scatter diagram.	Use of crosses for points and good scaling which does not waste undue space.	
The different types of correlation and how to recognise them. Comparing different correlations.	Diagrams to show the three different types and also the different strengths of correlation that can exist.	
A correlation between two variables may not mean that one caused the other.	The issue of cause and effect or even coincidence or other variables which are involved in a situation. (eg sales of sandwiches may be correlated to the temperature outside but other variables such as day of the week will be involved).	Find variables which appear to have a connection but can clearly not be one causing the other.
Calculating values of Spearman's correlation coefficient.	Knowing the -1 to +1 scale and the interpretation of values between those limits when they have been calculated or given.	Why does a SRCC of +1 not necessarily mean a perfect straight line for the data points.
Interpreting values of the Product Moment correlation coefficient.	Knowing the -1 to +1 scale and the differences between the PMCC and the SRCC.	Most able may consider PMCC calculations for CA

Scatter diagrams continued...		
How to draw lines of best fit on a scatter diagram and when it is acceptable to do so.	Discussion and examples to show why there needs to be a good degree of correlation before lines of best fit are attempted. Use of the double mean point and other criteria involved in drawing lines of best fit such as length of line to ends of data but not beyond.	Investigate whether interpolation within weak correlation or extrapolation outside strong correlation are equally likely to produce poor estimates.
How to use a line of best fit to estimate via interpolation and extrapolation.	Meaning of the words and their relevance in terms of likely reliability of the estimates found.	
Calculation and drawing of the equation of the line of best fit for sets of bivariate data. Non-linear data.	Obtaining an equation for the line of best fit in the form $y = mx + c$. An awareness of the possibility that data may form a nonlinear pattern.	Investigate the mathematical properties (such as the shape) of points that are non linear eg, quadratic or reciprocal functions.

Specification Section G Time Series (a little 3.1.3, mainly from 3.1.4)

In this section students need to understand that:

- time series graphs are used to show data that occurs over a period of time
- moving averages can be used to smooth out cycles in the data
- trend lines for the moving averages reveal overall trends
- how to calculate estimate of seasonal effects and use them for prediction
- how to draw and interpret output gap charts and Z charts.

Specification Content	Teaching and Learning Opportunities	Extension Possibilities
Time Series		
How to draw and interpret a time series line graph.	Data plotted and points joined as a continuous line graph.	Looking for real time series data on the internet.
How to choose and calculate appropriate moving averages.	Choice of number of values in moving average according to the number of items per 'cycle'. Plotted at midpoint of period covered by items in moving average.	
How to draw a trend line based on raw data or moving averages.	Trend line as a line of best fit drawn by eye for the plotted moving averages simply drawn for the original data.	
How to identify and calculate average seasonal effects and use them to predict future values.	Learning that the seasonal pattern should be visible from the shape of the time series. The value of seasonal effects is calculated as the average difference between the original and trend value. How this value is then used along with an extended trend line to make future predictions.	Comparing the specification method with other methods.
How to draw and interpret Z charts.	Simple situations only – understanding the meaning of the 3 lines making up a Z chart.	
How to draw and interpret output gap charts.	How these are a form of time series. Interpretation of these charts with references to basic economic terms such as boom and recession.	

Specification Section H Remaining Calculations and Methods of Graphing

In this section students need to understand that:

- charts and graphs can be used to mislead
- choropleth maps can show the distribution of items in an area
- data can be transformed from one form of representation to another
- index numbers can be used to compare prices and values over periods of time
- national index numbers such as RPI, CPI and GDP exist and their meaning
- weighted index numbers and chain base numbers can be calculated and interpreted
- crude rates are used to identify measures such as birth and death rates
- standardised rates are used to compare rates between areas
- production of items can be monitored by use of control charts.

Specification Content	**Teaching and Learning Opportunities**	**Extension Possibilities**
Remaining Calculations and Methods of Graphing		
How to recognise errors in diagrams such as scaling issues, misuse of area or volume. How to judge whether a diagram is well or poorly presented.	Lots of examples of diagrams that mislead or are simply poor for the usual reasons of wrong scales, missing origins, poor definitions and so on – showing examples from the media.	
Misuse of area and volume in pictorial representation. Calculations for area and volume presentations.	Calculating areas and volume to reveal errors in scaling or to make diagrams in 2D and 3D the appropriate size.	Draw some deliberately incorrect 2D or 3D diagrams to mislead your friends for a cause or fact you are interested in.
How to draw and interpret choropleth maps.	Practice and critical issues. Interpreting these diagrams when drawn.	Looking at world population density maps on the internet.
How to transform data from one form of presentation to another.	Good opportunity, if time allows, for revisiting some of the previously met diagrams.	
How to calculate and interpret simple index numbers, weighted index numbers, chain base numbers and the nationally known measures of these types namely RPI and CPI.	Describe the context of the use of these measures and how they are calculated. Showing how to interpret the results of these calculations. (the www.statistics.gov.uk website has good information on this). Differences in the RPI and CPI.	Look at the detailed construction of the RPI and CPI. Under what economic circumstances is one of these measures likely to be higher than the other.

Remaining Calculations and Methods of Graphing continued...		
How to calculate crude rates and interpret both crude and standardised rates.	In the contexts of births, deaths, and unemployment show how to work crude rates out and what they measure wiith reference to real examples. Examine the differences between crude and standardised rates and why standardised rates are fairer for comparison.	Very able students may benefit from investigating the calculation of standardised rates but this is not now on the specification.
How to use control charts to check issues of quality assurance.	How to plot sample means, medians or ranges and what action might be recommended as a result of the shapes or patterns of these graphs.	

Specification Section I (3.1.5 Probability)

In this section students need to understand that:

- words or values between 0 and 1 can be used for probabilities
- probability can be thought of as the limit of relative frequency
- equally likely events are important in calculating probabilities
- different pictorial forms of probability situations are available
- events can be mutually exclusive, independent or exhaustive and what this means
- the general addition and general multiplication laws exist and how and when they can be used
- tree diagrams can be used in certain probability situations
- conditional probabilities can be calculated often with the aid of tree diagrams
- estimation of population values can be made using sample values where appropriate
- other estimation methods exist such as the capture recapture technique
- variability of estimates varies with sample size.

Specification Content	**Teaching and Learning Opportunities**	**Extension Possibilities**
Probability		
How to use values to denote probabilities of events.	Introduction to probability as a measure of how likely an event is to occur, including a definition of 'event', and ‘outcome’. Brief resume for Higher.	
How to use equally likely events to find the probabilities of common compound events. Use of sample space diagrams to help determine probabilities.	What equally likely events are. When all events are listed, one of them is certain to occur, so the sum of their probabilities is 1. Using dice, coins, cards and so on.	
Recognise exhaustive, mutually exclusive and independent events and their roles in using the addition and the multiplication rules. A simple understanding of conditional probability. Diagrams such as Venn diagrams or Cartesian grids.	Examples and probabilities using sample space diagrams (as two-way tables). Defining mutually exclusive and independent events and the use of the multiplication rule to find the probabilities of independent events both happening. Understanding how probabilities can change given some prior information illustrated using some of these diagrams.	For very able students investigate the probabilities involved in winning prizes in the National Lottery (not only the Jackpot). Investigate the proportionality or otherwise between the probability of winning at a particular point and the approximate prize usually offered for that particular point.

Probability continued...		
How to use tree diagrams as an aid to finding probabilities of combined events.	Examples and introduction to how tree diagrams are drawn and used (with or without replacement and up to three stages at Higher Tier).	
Use probabilities to calculate expected frequencies.	Given the probability of an event how many times is it likely to occur in a set number of trials or experiments?	How many white Christmases are expected in the next 100 years?
Use of relative frequencies to estimate values for probabilities.	Introduction to relative frequency and how it is found. More trials leading to likely greater reliability of estimates.	
Using other estimation techniques such as capture recapture methods for, typically, estimating the number of fish in a lake.	Use of a mean of a sample or the proportion of an item in a sample as an estimate of the equivalent measure for the associated population.	
	The effect of sample size on the accuracy and reliability of samples. For example, to halve the variability of an estimate requires four times the sample size.	Able candidates could be introduced to the concept of standard error.