← Key Stage 2 | Key Stage 4 →

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	Autumn	Spring	Summer
Core Knowledge	<u>Number</u> - Find common factors of numbers and the highest common factors - Division with remainders expressed as a fraction , BIDMAS - applying to integers and decimals +/- and x or /÷ <u>Geometry</u> - Identify properties of the faces, surfaces, edges and vertices of shapes - Measurement of various shapes areas and perimeters including links to algebra for various shapes <u>Ratio, proportion and rates of change</u> - Explore ratio and idea of part to part, including notation and links to fractions - Application of metric conversions <u>Statistics and Probability</u> - Interpret and understand scales - Create and interpret pie & pie charts <u>Algebra</u> - Understand basic algebraic notation including characteristics of formala's, and expressions. - Understanding when and how to expand single brackets - Understand how to collect like terms	<u>Geometry</u> - Recognise and solve problems involving vertically opposite angles - Exploring and solving problems involving angles on a straight line - Understand how the volume of a cube or cuboid relates to area. - Understand the properties of a prism - Naming both the x and y axis. - Performing simple enlargement, reflection, rotation and translation <u>Ratio, proportion and rates of change</u> - Simplifying ratios with and without units - Conversion of units including time <u>Statistics and probability</u> - Gain an understanding of range, median, range and mode for simple data - Find averages from bar charts <u>Algebra</u> - Understand the difference between an expression, equation and formula - Interpret expressions as functions with inputs and outputs - Create and use a formula - Solving simple one and two step equations	<u>Number</u> - Understanding negative numbers in context i.e. temperature - Convert improper fractions to mixed number fractions and vice versa - Ordering fractions including different formats i.e. fractions, percentages and decimals <u>Geometry</u> - Know and understand $y = x$, $y = -x$ and using these lines to reflect in. - Know and understand naming of lines that are parallel to an axis <u>Ratio, proportion and rates of change</u> - Introduction of speed - Understand the unitary method. <u>Statistics and probability</u> - The language of probability - Simple theoretical probability as a fraction - Probability as a decimal or percentage <u>Algebra</u> - Plotting & drawing a line given an equation with substitution. - The language of sequences - Generating a sequence and finding the nth term
Concepts	• Concept and vocabulary of prime numbers, factors (divisors), multiples and common factors, area & perimeter, algebraic terms. • Concept of addition and subtraction with negatives, concept of multiplying terms • Conception of bar and pie charts as representing data • Concept of an unknown in algebra	• Concepts of relationships between intersecting lines and opposite angles • Concept of volume being an extension from area in cubes. • Concept of a transformation being a way to describe a shapes movement • Concept of inverse operations for solving equations	• Concept of mixed number fractions and improper being the same value • Concept of a fraction being the same as a percentage & decimal • Concept of fairness and probability as a scale • Concept of a rule in sequences • Concept of calculated probability being theoretical
Other connections	• Connections to other areas of maths such as algebra, geometry and statistics. • Connections to other subjects such as chemistry (balancing equations) and physics (calculating wavelength and frequency)	• Connections to other areas of maths such as angles in parallel lines, comparing data and worded algebraic problems. • Connections to physics (reflection, refraction) and geography (population size)	• Connections to other areas of maths such as using graphs to solve equations and direct & inverse proportion. • Connections to Chemistry, food tech and Physics (temperature affecting chemical structure)
Post Connections	Write a number as a product of its prime factors, use standard form to write large numbers, use standard form to write small numbers, problem solving, calculating with time using number line, multiply and divide negative numbers, introduce of the calculator with time, properties of circles, compass work, nets of prisms and pyramids, plans and elevations.	Averages from a simple frequency table (introducing the notation of sigma), compare 2 distributions using median and range, averages from stem and leaf diagrams, write an expression that involves brackets, Using and writing of inverse machines, single and double, Substitution of negative numbers, including use of calculator with negative numbers.	Find the next term, a term missing in the middle of a sequence and explain why this is, given the line find the intercept and begin to find the gradient, Look at the common sequences - square/cube numbers, triangular numbers, listing outcomes: sample space diagrams, introduction theoretical probability of multiple events i.e. multiplication rule.
Vocabulary	Face, Edge, Vertex (Vertices), Cube, Cuboid, Prism, Cylinder, Pyramid, Cone, Sphere, Lowest common multiple and LCM, Highest common factor and HCF, Power, square and cube root, Triangular number, Square number, Cube number, Prime number. Improper fraction, Top-heavy fraction, Mixed number, Operation, Inverse, Long multiplication, Short division, Long division, Remainder.	Face, Edge, Vertex (Vertices), Cube, Cuboid, Prism, Cylinder, Pyramid, Cone, Sphere, Lowest common multiple and LCM, Highest common factor and HCF, transformation, rotation, reflection, enlargement, translation, scale factor, centre of enlargement, centre of rotation, vector, median, mean, range, mode, functions, formula, solve, equation, balancing, inverse, function, operation.	Fraction, Mixed number, Top-heavy fraction, Percentage, Decimal, Proportion, Terminating, Simplify, Cancel,Plot, Equation (of a graph), Function, Formula, Linear, Coordinate plane, Gradient, Y-intercept, Substitute, Quadratic, linear, Model, Kinematic, Speed, Distance, Ratio, Proportion, Proportional, Multiplier, Speed, Unitary method, Units, Compound unit
Assessment	GL baseline assessment, pixi assessment, PUMA assessment.	Pixi assessment, PUMA assessment.	Pixi assessment, PUMA assessment.

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	Autumn	Spring	Summer
Core Knowledge	<u>Number</u> - Prime factorisation of integers - The use of standard form for writing large and small numbers - Writing inequalities on a number line with the correct notation. <u>Ratio, proportion and rates of change</u> - Sharing an amount using a ratio - Calculating speed, distance and time depending on given values <u>Geometry</u> - Properties of a circle - Constructions of triangles with a compass - Drawing nets of more complicated 3d shapes such as prisms and pyramids - Exploring angles in special triangles and parallelograms <u>Algebra</u> - Expanding harder single brackets and solving them - Reading and writing inverse function machines - Solving calculations which have been substituted into with values <u>Statistics and probability</u> - Finding averages from frequency tables - Creating and using stem and leaf diagrams to find averages	<u>Algebra</u> - Solve (balance) equations with one unknown and one pair of brackets - Solving (balance) equations with fractions i.e. $\frac{1}{3}x = 5$ - Extend to solving with unknowns on both sides i.e. $2x + 3 = 3x - 2$ <u>Geometry</u> - Exploring reflection in two mirror lines - Rotate a shape with centre off the shape - Enlargement with a centre on a vertex and off with positive scale factors <u>Ratio, proportion and rates of changes</u> - Develop upon and use the unitary method - use the unitary method to find "best buy" solutions <u>Number</u> - Using calculator recurring symbol - Write a terminating decimal as a fraction <u>Statistics and probability</u> - Present/interpret data in compound/comparative bar charts - Present/interpret data in scatter graphs - Draw LOBF: describe the correlation.	<u>Geometry</u> - Volumes of prisms including triangular & compound shapes using FSS - Total surface area of prisms including triangular prisms using FSS - Combining transformations which can also be written as a single transformation. <u>Statistics and probability</u> - Using Venn diagrams to find probabilities. - Listing outcomes using a sample space diagram - Theoretical multiple event probability using fractions <u>Algebra</u> - Use substitution to generate terms in a sequence when given the nth term - Look at common sequences that might involve square, cube and triangular numbers <u>Number</u> - Discovering how to use a calculator with various functions such as squaring, cubing, fractions etc. - Using all four operations on decimals <u>Ratio, proportion and rates of change</u> - Problem solving with proportion - Introducing the concept of direct and inverse proportion. - Solve worded problems with ratio
Concepts	• Concept that any integer can be made, with multiplication, with prime numbers • Concept that powers of 10 can be used to make very large and very small numbers. • Concept that expanding brackets or factorising into brackets shows the same expression but in a different format	• Concept that when solving an equation, an operation must happen to both sides of the = symbol to keep it balanced. • Concept that a recurring decimal can be written in a simpler way - a fraction • Concept that a line of best fit is an approximation and can be used for predictions.	• Concept that a 3d shape can have an area and not just a volume • Concept that a small range can show the reliability of data • Concept that a sequence can involve powers • Concept that multiple event outcomes will happen less than single event outcomes therefore the events need to be multiplied
Other connections	• Connections to other areas of maths such as quadratics in algebra and congruent & similar triangles in geometry. • Connections to Physics (standard form) and Geography (earthquakes foci and epicenter)	• Connections to other areas of maths such as area, volume and perimeter & enlargement with a negative scale factor. • Connections to biology (when using graphs when mapping the relationships between variables)	• Connections to other areas of maths such as algebra (formulas and quadratic sequences) and proportionality (equations of proportionality) • Connections to business studies and economics with proportion
Post Connections	Write a number as a product of its prime factors, Use prime factorisations to find the highest common factor of two numbers, Name the angle rules in parallelogram, Perfect angle rule sentences, phrase interior angles and extend triangles/quadrilaterals to other polygons, Rearrange (Make the subject), substitution then rearrange/solve.	Solve simple quadratics with a = 1, Solve simple simultaneous equations, Solve (balance) a basic inequality, Describe rotations, Describe reflection in two mirror lines as a rotation, Introduction fractional Enlargement, translation and rotation, Find the centre of enlargement for positive scale factor, Use standard form on a scientific calculator including	Introduction of probability trees replacement leading to no replacements, use probability to calculate expected outcomes (relative frequency), Introduction of Enlargement sf as a fraction, Combinations of reflection, translation and rotation - describe resulting shape using a single, transformation, exploring Pythagoras theorem
Vocabulary	Degrees, Right angle, acute angle, obtuse angle, reflex angle, Vertically opposite, Parallel, Alternate angles, corresponding angles, Interior angle, exterior angle, Regular polygon, Prime, Prime factor, Prime factorisation, Product, Venn diagram, Highest common factor, Lowest common multiple, Standard form, Significant figure, Inequality, Expression, Term, Formula, Equation, Function, Variable	Prime, Prime factor, Prime factorisation, Product, Venn diagram, Highest common factor, Lowest common multiple, Standard form, Significant figure, Inequality, Unknown, Equation, Operation, Solve, Solution, Brackets, Symbol, Axis, axes, x-axis, y-axis, Origin, Quadrant, Translation, Reflection, Rotation, Transformation, Object, Image, Congruent, congruence, Vector.	Negative number, Directed number, Improper fraction, Top-heavy fraction, Mixed number, Inverse, Long multiplication, Square numbers, Cube numbers, Term, Difference, Term-to-term rule, Position-to-term rule, Ascending, Descending,Radius, diameter, chord, circumference, Pi (π), prism, Cross-section, Cylinder, Polygon, polygonal, Solid
Assessment	Pixi assessment, PUMA assessment.	Pixi assessment, PUMA assessment.	Pixi assessment, PUMA assessment.

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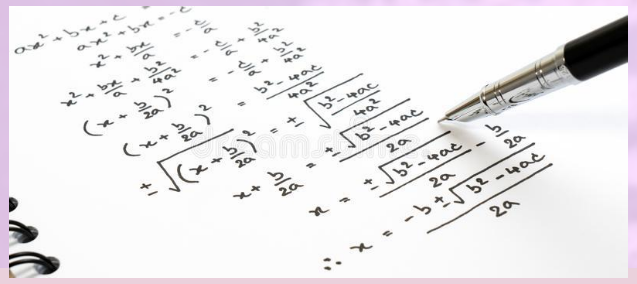
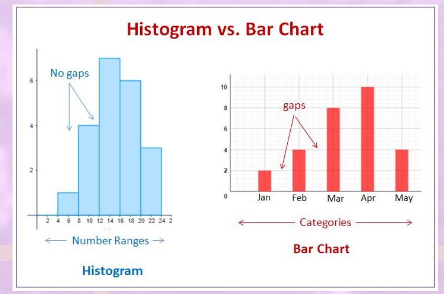
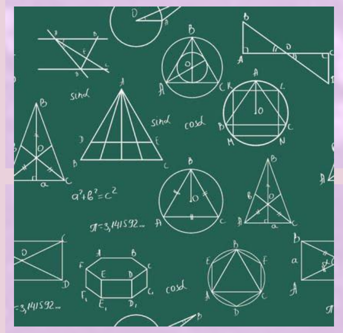
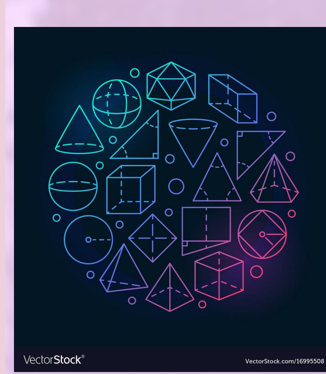
	Autumn	Spring	Summer
Core Knowledge	<u>Number</u> - Being able to write a quantity as a fraction, decimal or percentage of another quantity. - Finding a multiplier for the use of percentage increase or decrease. - Problem solving involving all four operations for whole numbers, decimals and fractions <u>Ratio, proportion and rates of change</u> - Maps and scale, including recap of metric conversions. <u>Geometry</u> - Know the formulae: circumference of a circle = $2\pi r = \pi d$ and area of a circle = πr^2 <u>Statistics and probability</u> - Understanding averages from a discrete frequency table - Averages from a continuous data frequency table <u>Algebra</u> - Understanding the laws of indices - Expanding double brackets - State the gradient and y intercept when given an equation - Draw a linear graph when given an equation using a table of values - Calculate the gradient of a straight line on a graph.	<u>Algebra</u> - Rearranging an equation to make a variable the subject. - Generate a quadratic sequence when given the nth term - Know the Fibonacci sequence and being able to create similar sequences <u>Number</u> - Writing any large number and any small number with standard form - Using venn diagrams and prime factorisations to find the highest common factor or lowest common multiple of any number. <u>Geometry</u> - Construct a perpendicular bisector of a line and through a point - Bisect and angle - understand the definition of Loci and use it to answer a question. <u>Statistics and probability</u> - Interpret a graph or chart and to find sample sizes. - Introduction to histograms - Probability trees with and without replacement. <u>Ratio, proportion and rates of change</u> - Finding exchange rates with the unitary method. - Introducing graphs of proportionality	<u>Number</u> - Identifying the multiplier for percentage change and applying it - Finding original values after a percentage increase or decrease - Compare simple and compound interest for best options <u>Geometry</u> - Angles in parallel lines with intersecting lines and the rules involved. - Finding interior angles of polygons and understand how this relates to triangles. - Finding exterior angles for polygons. - Introduce bearings <u>Algebra</u> - Writing an expression which depicts a shapes area, perimeter or volume - Solving an equation which depicts a shapes area, perimeter or volume <u>Statistics and probability</u> - Finding the relative frequency from a set of data using inequalities - Using relative frequency to calculate probabilities - Introduction to experimental probability - Using cumulative frequency to calculate probabilities in experimental situations
Concepts	• The concept that a decimal can be used to find a percentage easily. • The concept that any circle's circumference divided by its diameter will give a mathematical constant π • The concept that a map is a scaled down or up version of something far bigger or smaller.	• The concept that an equation or formula can be adapted with the balancing method. • The concept of equidistance by using compass points. • The concept that a histogram shows a range of values in each bar. • The concept that a probability fraction changes if not replaced	• The concept that different interest types (compound and simple) are just as important as the interest rate multiplier. • The concept that alternate, corresponding and vertically opposite angles are the same. • The concept that a inequality can be used for finding a probability .
Other connections	• Connections to other areas of maths such as volume of a cone or sphere circle properties) and exponential growth (multiplier) • Connections to business, biology & economics (exponential growth of capital and bacteria)	• Connections to other areas of maths such as quadratic; graphs, equations and sequences. • Connections tp physics when rearranging equation & formula is used for finding voltage, current or different types of energy.	• Connections to other areas of maths such as circle theorems and trigonometric ratios. • Connections to PSHE with shopping (finding the best deal) and finding the best options for loans (interest rates).
Post Connections	Simple and compound interest incorporating exponential growth and decay, using bearings on maps incorporating constructions and trigonometry, using box plots to show the range of a data set, using indices in conjunction with surds, use expansion of brackets for finding areas and volumes, using linear graphs to find solutions to simultaneous equations	Rearranging an equation or formula and applying it to find a solution, writing quadratic expressions, solving quadratic equations, using venn diagrams for problem solving, solving a linear and quadratic equation simultaneously, using probability trees and venn diagrams with non replacement to find a theoretical probability, experimental probability	Calculating with standard form including multiplying and dividing, Use calculation of standard form to find solutions to real problems such as mass, density and volume questions, using bearings in conjunction with trigonometry, use rules for angles in parallelograms in conjunction with trigonometry and bearings.
Vocabulary	Circle, Pi, Radius, diameter, chord, circumference, arc, tangent, sector, segment, prism, cylinder, Power Root, Index, Indices, Standard form, Inequality, Truncate, Round Minimum, Maximum, Interval Decimal place, Equation Quadratic, cubic, reciprocal Gradient, y-intercept, x-intercept, root, Sketch, plot, Linear, non-linear	Equation, Simultaneous equation, Variable, Manipulate, Eliminate, Solve, Derive, Interpret, Term-to-term rule, nth term, Generate, Linear, Quadratic First (second) difference, Fibonacci number, Fibonacci sequence, Categorical data, Discrete data, Continuous data, Grouped data, Axis, axes, Compound bar chart Scatter graph	Outcome, equally likely outcomes, Event, independent event, dependent event, Tree diagrams, Theoretical probability, Experimental probability, Random, Bias, unbiased, fair, Relative frequency, Enumerate Set, P(A), Equation, Formula, Formulae, Linear, Expression, Quadratic, Interior, exterior, Alternate, co-interior, corresponding
Assessment	Pixi assessment, PUMA assessment.	Pixi assessment, PUMA assessment.	Pixi assessment, PUMA assessment, Foundation GCSE papers

PROGRESSION ➤

Mathematics

Excellence; for each, for all

Thomas Gainsborough School

← Key Stage 3		Year 10			Year 11	Key Stage 5 →
	Autumn	Spring	Summer	Autumn	Spring	Summer
Core Knowledge	Explore the properties of 2D & 3D shapes. Construct triangles, perpendiculars, bisect angles and solve loci problems. Use the properties of shapes and angle facts to solve geometric problems. Exploring the applications of the 4 operators with positives, negatives, decimals and fractions. Investigate the properties of numbers with factors, multiplies, primes, powers and roots. Calculate with and interpret standard form and bounds. Review algebra concepts; expand and simplify expressions, rearrange formula, substitute into and solve equations. Use negative numbers within algebra and apply the four operators to algebraic fractions. Generate sequences, explore well known sequences and find the nth term of linear and quadratic sequences. Carry out and describe transformations; rotations, reflections, translations and enlargements. Convert between and work with fractions, decimals and percentages. Percentage work to include reverse % and compound interest. **Work with recurring decimals.** Balancing linear equations, working with quadratics, graphing linear problems. **Introduction to functions**.	Use and understand y = mx + c, rearrange formula and find the equation of a line given a gradient and a coordinate or two coordinates. Know and apply Pythagoras. **Work with perpendicular lines**. **Identify a circle from its graph and equation and solve problems with tangents.** Recall formula, calculate volume and surface area. Use Pythagoras in pyramids and cone problems. Solve problems with solids. **Understand the impact of enlargements on area and volume. Solve problems with scale factors.** Use the four inequality signs, solve inequalities and use set notation, and plot graphs of linear functions. **Graph inequalities and determine regions. Solve inequalities in 2 variables, represent solutions using set notation.** Interpret graphs and equations that describe direct and inverse proportion. Solve problems with combining ratios. Solve problems with density and speed. **Solve complex problems with ratio & percentage and compound measures.** Plot non linear functions, solve problems with gradient and find solutions from quadratic graphs. **Recognise and plot exponential graphs. Make use of non standard graphs to solve problems with kinematics. Work with the gradient and area under a curved graph. Root, intercepts and turning points of quadratic functions.**	Apply the product rule, use set notation with Venn diagrams. Use Venn diagrams and two way tables to calculate theoretical probabilities. Calculate and **interpret** conditional probabilities. Solve quadratic equations by rearranging, factorising and estimating from a graph thus making connections between the equations and their graphs. Deduce quadratic roots algebraically and solve problems that lead to solving quadratics. Label right angle triangles, recall and select the appropriate trigonometric ratio to calculate missing lengths and angles. Establish and recall the required exact trigonometry values. Use trigonometry to solve problems with bearings. Make use of a samples and quartiles to understand data. Construct, interpret and compare box plots and cumulative frequency curves. **Apply the Petersen capture-recapture method.** Solve simultaneous equations by elimination and **substitution** using 2 variables with multiplication or division on one or both **equations** required leading to **fractional coefficients. Derive, solve and interpret two simultaneous equations. Understand and use the iterative process.** Use vector notation, add & subtract vectors, multiply by a scalar and solve simple geometrical problems. **Solve more complicated geometrical problems with vectors**.	Use and apply Pythagoras' theorem to find missing lengths in 3D figures. Use trigonometry to find the angle between a line and a plane and solve problems involving missing lengths and angle in 3D. **Use and apply the sine and cosine rule and calculate the area of non right angle triangles.** Work with ratio and solve proportion problems. **Construct, use and solve equations in direct and inverse proportion**. Rearrange equations involving fractions that lead to quadratic equations. Use and apply the quadratic formula. **Complete the square for a quadratic equation and solve. Deduce the turning point and roots of a quadratic function. Solve problems involving quadratic equations. Derive the iterative formula to approximate the solution of an equation.** Carry out enlargements from a centre with positive and fractional scale factor. Find the centre of enlargement and scale factor of an enlargement.. **Carry out and find an enlargement with a negative scale factor.** Plot an exponential graph. **Plot and use the key features of the trigonometric graphs. Know the effects of transformations on graphs and as such solve problems.** **Apply the concept of average rate of change and instantaneous rate of change in numerical, algebraic and graphical contexts and solve problems.**	**Solve quadratic inequalities. Solve simultaneous equations in two variables by substitution and elimination.. Solve simultaneous equations with one non linear equation, make connections between equations and graphs and solve problems.** **Understand, construct and interpret histograms.** **Know and use surd notation, simplify surds and solve problems. Multiply brackets with surds and simplify. Rationalise the denominator of simple and more complex surd expressions.** **Understand the meaning of a function, use the notation and problems for composite functions. Find and solve problems with inverse functions.** Calculate angles around a point, between parallel lines and in polygons. Use these facts to solve multi step problem and geometrical proofs. **Recall, use, apply and prove standard circle theorems to solve geometrical problems.** **Create and present proof with vectors. Make deductions about situation involving vectors that are multiples of other vectors, expressed using ratios and that have parallel lines.** 	Students will review and consolidate prior learning by following a personalised revision programme created by their teacher. They will undertake exam practice to prepare them fully for their upcoming GCSE. Paper 1 – 25th May 2021 Paper 2 – 8th June 2021 Paper 3 – 15th June 2021 
Concepts	**Units**: Properties of Shape Calculating Expressions Sequences Mathematical Movement Exploring fractions, decimals and percentages Equations	**Units**: Graphs 1 Calculating Space Solving inequalities Proportional Reasoning Graphs 2	**Units**: Probability Solving Quadratics Trigonometry Statistics Solving Simultaneous equations Vectors	**Units**: Pythagoras and Trigonometry Proportional reasoning Solving Quadratic equations 2 Similar shapes Exponential and Trig graphs Rates of change (H)	**Units**: Quadratic sim equations and inequalities (H) Histograms (H) Surds (H) Functions (H) Circle Theorems (H) Proof using vectors (H)	
Other Connections	Geometry and construction are used in the Art curriculum. Construction techniques may be used in Design & Technology. Standard form is used within Science. Tessellations and transformations used in ART and Technology	Sequences and patterns. Calculating with perimeter and area. Balancing equations. Plotting straight line graphs. Calculating with ratios.	Fractions, decimal and percentages. Transformations of graphs. Plotting quadratic functions. Collecting like terms.	Solving Quadratic equations 1. Non linear graphs.	Solving Quadratic equations. Powers and roots. Angle facts.	
	➤	➤	➤	➤	➤	➤
Post Connections	CAD technical drawing. Best buy problems in every day life.	Sales and Marketing, Economics, Business, Psychology, Science and Medicine, Engineering.	You use probability in daily life to make decisions when you don't know for sure what the outcome will be. Trigonometry is used in Oceanography and has applications in satellite systems.	In architecture similar triangles are used to represent doors and how far they swing open. Also when you use shadows that make triangles to find the height of an object	Surds are used in real life to make sure that important calculations are precise, for example by engineers building bridges.	
Vocabulary	Compasses, Arc, Line segment, Perpendicular, Bisect, Perpendicular, bisector, Locus, Loci, Plan, Elevation. Power, Root, Index, Indices, Standard form, Inequality, Truncate, Round, Minimum bound, Maximum bound, Interval, Decimal place, Significant figure, Limit. Term, nth term, Generate, Quadratic, First (second), difference, Geometric Progression, Perpendicular, bisector, Scale Factor, Similar, Congruent, Invariance, Transformation, Rotation, Reflection, Translation, Enlargement. Fraction, Mixed number, Top-heavy fraction, Percentage change, percentage increase, percentage increase, Compound interest, Simple interest, Terminating decimal, Recurring decimal, (Exponential) growth, decay. Equivalent, Equation, Expression, Expand, Linear, Quadratic, Algebraic Fraction, Difference of two squares, Binomial, Factorise. (Linear) equation, Variable, Manipulate, Solve, Solution, Integer.	Function, equation, Linear, non-linear, Parallel, Perpendicular, Gradient, y-intercept, x-intercept, root, Sketch, plot, Centre (of a circle), Radius, Tangent. (Composite) solid, Sphere, Pyramid, Cone, Perpendicular (height), (slant height), Surface area, Volume, Congruent, congruence, Similarity, similar shapes, similar figures, Enlarge, enlargement, Scale factor. Linear inequality, Variable, Manipulate, Solve, Solution set, Integer, Set notation, Region. Direct proportion, Inverse proportion, Multiplier. Function, equation, Linear, non-linear, Quadratic, cubic, reciprocal, exponential, Parabola, Asymptote, Gradient, y-intercept, x-intercept, root, Rate of change, Sketch, plot, Kinematic, Speed, distance, time, Acceleration, deceleration.	Outcome, equally likely outcomes, Event, independent event, dependent event, Tree diagrams, Theoretical probability, experimental probability, Random, Bias, unbiased, fair, Enumerate, Set, Conditional probability, Venn diagram. (Quadratic) equation, Factorise, Rearrange, Variable, Unknown, Manipulate, Solve, Deduce, x-intercept, Root. Similar, Opposite, Adjacent, Hypotenuse, Trigonometry, Function, Ratio, Sine, Cosine, Tangent, Angle of elevation, angle of depression. Categorical data, Discrete data, Continuous data, Grouped data, Axis, axes, Population, Sample, Cumulative frequency, Box plot, box-and-whisker diagram, Central tendency, Mean, median, mode, Spread, dispersion, consistency, Range, Interquartile range, Skewness. Unknown, Solve, Solution set, Interval, Decimal search, Iteration, Simultaneous equations, Substitution, Elimination. Vector, Scalar, Constant, Magnitude.	Diagonal (Face Diagonal, Space Diagonal), Plane, Opposite, Adjacent, Hypotenuse, Trigonometry, Sine, Cosine, Tangent, Angle of elevation, angle of depression. Direct, proportion, Inverse proportion, Multiplier. (Quadratic) Equation, Factorise, Rearrange, Complete the square, Unknown, Manipulate, Maximum, minimum, Parabola, Recurrence relation, Interval bisection. Scale Factor, Similar, Transformation, Enlargement. Exponential, Function, equation, Linear, non-linear, Quadratic, cubic, reciprocal, exponential, Parabola, Asymptote, Maximum, minimum, period, Gradient, y-intercept, x-intercept, root, Sketch, plot, Arguments. Function, Complete the square, Deduce, Root, Turning point, minimum, maximum, Rate of change, Chord, Tangent, Average rate of change, Instantaneous rate of change.	Unknown, (Quadratic) inequality, Variable, Manipulate, Solve, Solution set, Simultaneous equations, Substitution, Elimination. Continuous data, Grouped data, Table, Frequency table, Frequency, Frequency density, Histogram, Scale, Graph, Axis, axes. Power, Root, Index, Indices, Surd, Simplify, Rationalise. Mapping, Function, Inverse function, Composite function. Radius, radii, Tangent, Chord, Theorem, Conjecture, Derive, Prove, proof, Counterexample. Vector, Scalar, Constant, Magnitude, Collinear.	
Assessment	Quests - Properties of Shapes, Calculating, Expressions, Sequences, Mathematical movement, Exploring fractions, decimals and percentages, Equations End of term - GCSE Paper 1&2	Quests - Graphs 1, Calculating space, Solving inequalities, Proportional reasoning, Probability Year 10 Mock - GCSE full set	Quests - Solving quadratics, Graphs 2, Trigonometry, Statistics, Solving simultaneous equations, Vectors End of Year - GCSE Full set	Quests - Pythagoras and Trigonometry, Proportional reasoning, Solving quadratic equations 2, Similar shapes, Exponential and trigonometric graphs, Rates of change (H) Year 11 Mock - GCSE full set	Quests - Higher only - Quadratic simultaneous equations, Histograms, Surds, Functions, Circle theorems, Proof using vectors Year 11 Mock 2 - GCSE full set	Year 11 Mock 3 - GCSE full set

Mathematics

Excellence; for each, for all

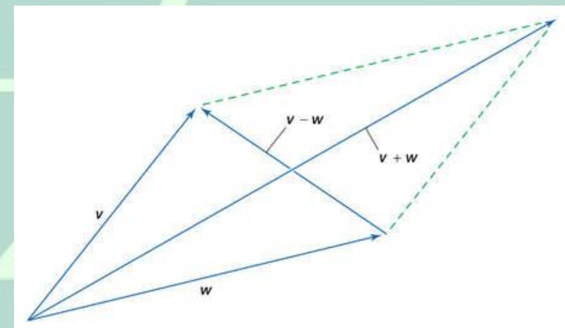
Thomas Gainsborough School

← Key Stage 4		Year 12			Year 13	University ˆ Employment →
	Autumn	Spring	Summer	Autumn	Spring	Summer
GCSE Maths Grade 7 or above Core Knowledge	**Pure** Understand and use the laws of indices and surds and work with quadratic functions. Solve simultaneous equations and inequalities, manipulate polynomials and make links with algebra and the graphical representations. Use graphs of functions and apply transformations. Work with the equation of straight line graphs in a variety of contexts. Use and apply coordinate geometry with circles. Use and apply methods of proof. **Statistics and Mechanics** Use, select and critique sampling methods. Interpret measures of central tendency, locations & spread. Calculate variance and standard deviation and work with coding. Represent data with box plots, cumulative frequency and histograms. Compare data and understand outliers. Use and apply probability and understand probability distributions, binomial distributions and cumulative probabilities. Understand and apply the language of and conduct a statistical hypothesis testing.	**Pure** Use and apply sine & cosine rules and calculate the area of a triangle. Work with trigonometric identities and solve trigonometric equations. Use vectors in 2 dimensions, calculate magnitude, convert between different vector forms, use position vectors and solve vector problems. Differentiate from first principles. Use differentiation in application to gradients tangents and normal, increasing & decreasing functions, stationary points and modelling. Integrate with definite and indefinite integrals and apply to the area under curve. **Statistics and Mechanics** Use modelling in mechanics to simplify problems. Understand the standard units used. Work with distance-time and velocity-time graphs. Calculate and solve problems with the constant acceleration formulae and vertical motion under gravity, Start to work with forces and motion in 2 dimensions extending to connected particles and pulleys.	**Pure** Understand exponential graphs and use them for modelling. Learn and apply the rules of logarithms, solve equations in logarithms and work with natural logarithms. Solve problems and model logarithms relationships and linear. **Statistics and Mechanics** Use calculus in kinematics for motion in a straight line. Work with functions of time and apply differentiation, work with maxima and minima problems, use integration vectors and constant acceleration formula.	**Pure** Work with populations, samples, sampling and large data sets. Find the modulus of a linear function, work with composite functions and understand the effect of transformations on a function. Understand and use the inverse function. Work with arithmetic and geometric sequences. Use sum to infinity, sigma notation and recurrence relations. Understand and use the binomial expansion and its use for approximation. Calculate with angles in radians and solve problems with sectors. Solve trigonometric equations and use small angle approximations. Understand and use the definitions of secant, cosecant and cotangent and of arcsin, arccos and arctan, work with angles in radians and prove further identities, use double angle formulae and model with Trigonometric functions. Use and model with parametric equations. **Statistics and Mechanics** Work with exponential models, correlation and hypothesis testing for zero correlation. Explore conditional probability, transformations and modulus problem.	**Pure** Understand and use differentiation from first principles and use and apply a variety of new differentiation rules. Locate roots if f(x)=0, solve equations approximately using iteration, use the Newton-Raphson method and applications to modelling. Understand and use different integration methods, use the trapezium rule and apply knowledge to modelling with differential equations. **Statistics and Mechanics** Understand and use the normal distribution as a model and find probabilities. Use standard normal distribution and inverse normal distribution and conduct a statistical hypothesis test for the mean of the Normal distribution. Understand and use moments in simple static contexts.	**Pure** Use vectors in 3 dimensions, solve geometric problems and make links to mechanics. **Statistics and Mechanics** Resolve forces in 2 dimensions, on inclined planes and with friction present. Model motion under gravity in a vertical plane using vectors; projectiles. Understand and use Newton's second and third law when working with statics of a particle. Solve problems with friction and rigid bodies. Solve problems with dynamics, inclined planes and connected particles. Extend the constant acceleration formulae of motion to 2 dimensions using vectors. Use calculus in kinematics for (variable acceleration) motion in a straight line. Extend to 2 dimensions using vectors.
Concepts	**Pure** Algebraic Expressions, Quadratics, Equations and Inequalities, Graphs and Transformations, Straight Line Graphs, Circles, Algebraic Methods. **Statistics and Mechanics** Data Collection, Measures of Location and Spread, Representations of Data, Correlation, The Binomial Expressions, Probability, Statistical, Distributions, Hypothesis Testing.	**Pure** Trigonometric Ratios, Trigonometric Identities and Equations, Vectors, Differentiation, Integration. **Statistics and Mechanics** Modelling in Mechanics, Constant Acceleration, Forces and Motions.	**Pure** Exponentials and Logarithms **Statistics and Mechanics** Variable Acceleration	**Pure** Algebraic Methods, Sequences and Series, Binomial Expansion, Radians, Trigonometric Functions, Trigonometry and Modelling, Parametric Equations, Differentiation. **Statistics and Mechanics** Regression, correlation and hypothesis testing, Conditional probability, Numerical Methods, The Normal Distribution.	**Pure** Integration **Statistics and Mechanics** Moments	**Pure** Vectors **Statistics and Mechanics** Forces and Friction, Projectiles, Applications of Forces, Further Kinematics.
Post Connections	Chapter 2 PURE A Level PURE, A Level Statistics & Kinematics	AS Mechanics A Level Integration	A Level Mechanics	A Level Integration – Trigonometry A Level Mechcanics A Level statistics - binomial distribution.	Proof may also be tested throughout the specification through other topics e.g. trigonometry, series, differentiation, etc.	
Other Connections	**Pure** ***Computer scientist*** *use indices o describe very large numbers. A* ***quantum computer*** *with 1000 qubits (quantum bits) can consider* 2^{1000} *values simultaneously. This is greater than the number of particles in the observable universe.* ***Food scientists*** *use regions to graph and optimise athletes' nutritional intake and ensure they satisfy the minimum dietary requirement for calories and vitamins.* *Straight Line graphs are used in mathematical modelling.* ***Economists*** *use straight line graphs to model how the price and availability of a good affect the supply and demand.* *Geostationary orbits are circular orbits around the Earth.* ***Meteorologists*** *use geostationary satellites to provide information about the Earth's surface and atmosphere.* **Statistics and Mechanics** ***Wildlife biologist*** *use statistics such as mean wingspan and standard deviation to compare populations of endangered birds in different habitats..* *Graphs and charts appear all the time in* ***newspapers and magazines****, often stylised to suit the nature of the article.* ***Climate Scientists*** *have demonstrated a strong correlation between greenhouse gas emissions and rising atmospheric temperatures.* ***Sports teams*** *use past performance to estimate probabilities and plan strategies. In softball and baseball, a player's batting average is an estimate of the probability that they will make the hit*	**Pure** *Trigonometry in both two and three dimension is used by surveyors to work out distances and areas when planning* ***building projects****. You will also use trigonometry when working with vectors quantities in mechanics.* ***Pilots*** *use vector addition to work out the resultant vector for their speed and heading when a plane encounters a strong cross-wind.* ***Engineers*** *also use vectors to work out the resultant forces acting on structures in construction.* **Statistics and Mechanics** *Mechanics is the branch of mathematics which deals with the action of forces on objects. Mechanics can be used to answer questions about many familiar situations –* ***the motion of cars, the speed of a parachutist, the stresses in a bridge or the motion of the Earth around the Sun.*** *A body falling freely under gravity can be modelled as having constant acceleration. You can use this to estimate the time it will take a* ***cliff diver*** *to reach the water.* *The weight of an air-sea crew man is balanced by the tension in the cable. By modelling the forces in this situation, you can calculate how strong the cable needs to be.*	**Pure** *Logarithms are used to report and compare* ***earthquakes****. Both the Richter scale and the newer moment magnitude scale use base 10 logarithms to express the size of* ***seismic activity****.* **Statistics and Mechanics** *A* ***space rocket*** *experiences variable acceleration during launch. The rate of change of velocity increase to enable the rocket to escape the gravitational pull of the Earth.*	**Pure** *You can use proof by contradiction to prove that there is infinite number of prime numbers. Very large prime numbers are used to* ***encode chip and pin transactions.*** ***Codebreakers*** *at Bletchley Park used inverse functions to decode enemy messages during World War 11. When the enemy encoded a message they used a function. The code breakers' challenge was to find the inverse of that function that would decode the message.* *Sequences and series can be found in nature, and can be used to* ***model population growth*** *or decline, or the spread of a virus.* ***Statistics and Mechanics*** *Ice cream sellers typically find that they sell more ice cream the hotter the day. You can measure the strength of this correlation using the product moment correlation coefficient. The outcome of one event can affect the probability for another event. If a football team scores a goal, the probability that the will win the match will increase*	**Pure** *You can use differentiation to find rates of change in trigonometric and exponential models. The velocity of a wrecking ball could be estimated by modelling its displacement then differentiating.* *Integration can be used to solve differential equations. Archaeologists use differential equations to estimate the age fossilised plants and animals.* **Statistics and Mechanics** *Biologist use the normal distribution to model the distributions of physical characteristics, such as height and mass in large populations.* *Moments measure the turning effects of a force. Engineers use moments to work out how much load can be applied safely to a crane.*	**Pure** *You can use vectors to describe relative positions in three dimensions. This allows you to solve geometrical problems in three dimensions and determine properties of 3D solids.* **Statistics and Mechanics** *A car's braking force is determined by its speed and frictional force between the car's wheels and the road. In wet or icy conditions, friction is reduced so the braking distance is increased.* *A particle moving in a vertical plane under the action of gravity is sometimes called a Projectile. You can use projectile motion to model the flight of a basketball.* *A tightrope walker uses a mathematical model to calculate the tension in his wire. This allows him to make sure the wire is strong enough to hold his weight safely.* *Vectors are used to represent motion in two and three dimensions. The surface of the ocean can be modelled as a two-dimensional plane, and the velocity of a ship can be described using a vector.*
Vocabulary	Rationalise, turning point, discriminant, irrational, asymptote, coefficient, simultaneous, polynomial, quotient, root, exponent, quartic, infinity, bisect, factorise, stratified, quota, systematic, linear regression, interpercentile, skew, extrapolation, variance, deviation.	Interval, amplitude, period, identity, collinear, scalar product, modulus, first principles, normal, stationary, calculus, indefinite, intersection, modelling, inextensible, tension, thrust, friction, retardation, deceleration, gravity,	Exponential, exponent, logarithm, base, compound interest, Distance, displacement, variable acceleration, retardation, deceleration, differentiate, integrate, rate of change, with respect to time, constant of integration, initial conditions.	Validity, converges, diverges. Composite, domain, range, modulus. Series, finite, summations, sigma, periodicity, geometric progression. Partial fraction. Radian, interval, secant, cosecant, cotangent. Parametric, Cartesian. Critical value, inference.	Derivative, quotient, rate of change, inflexion, parametric, stationary point, turning point. Interval, iteration, Newton-Raphson, staircase, cobweb, trapezium rule. First order, by parts, reciprocal, indefinite. Position vector, orthogonal. Turning effect, centre of mass.	Scalar, column, 3D coordinates. Cartesian, i, j, k, unit vector, orthogonal. Coefficient of friction, negligible, inextensible, equilibrium, limiting, tension, thrust. Gravity, angle of projection, acceleration, projectile, trajectory, parabola. Concurrent, coplanar, instantaneously.
Assessment	Baseline Assessment , Unit 1, 2 & 3 PURE Unit 1, 2, 3, 4 & 5 Stats and Mechanics	Unit 4, 5, 6 & 7 PURE Unit 6, 7 & 8 Stats and Mechanics	Unit 8 PURE Unit 9 Stats and Mechanics	Unit 1, 2, 3, 3, 4, 5, 6 & 7 PURE Unit 1 & 2 Stats and Mechanics	Unit 8, 9, 10 & 11 PURE Unit 3 & 4 Stats and Mechanics	Unit 12 PURE Unit 5, 6, 7 & 8 Stats and Mechanics

Further Mathematical Qualifications/degrees in:
Mathematics
Statistics
Experimental physics
Theoretical physics
Astrophysics
Engineering
Aeronautical engineering
Civil engineering
Architecture
Economics
Financial Mathematics
Computer science
Software design
Chemistry
Biochemistry
Actuarial science
Accounting
Geology

Top Maths Universities
Cambridge
Oxford
York
Manchester
Bath
Kings
Southampton
Durham
St Andrews
Imperial
UCLA (USA)
Princeton (USA)
Harvard (USA)
Cal Tech (USA)
MIT (USA)

Careers in Maths
Accountant, astronomer, actuarial analyst, quantitative analyst, astronaut, aerospace engineering, CAD designer, meteorologist, theoretical physicist, cryptography, statistician, data manager, stock broker, stock trader, Lecturer, Civil engineer, surveyor, RAF pilot, airline pilot, MI5 and MI6, game designer, software development, architect, mathematical research, author, professor.



Mathematics

Excellence; for each, for all

Thomas Gainsborough School

← Key Stage 3

Statistics

	Year 10			Year 11	
	Autumn	Spring	Summer	Autumn	Spring

Core Knowledge

Year 10 – Autumn: Collection of data

Foundation

Use Correct terminology to describe different types of data and know the difference between them
Know how to group rounded and unrounded data into class intervals or categories and the advantages and disadvantages of doing so.
Understand population, sample and sample frame, and identify these for a given set of data
Know and be able to describe different methods of random and non-random sampling, including the advantages of each.
Select a sample stratified by one category
Know the key features to consider when planning interviews and questionnaires.
Write and identify suitable questions for investigations.
Write a hypothesis and decide on suitable data to collect and test it.
Design a data collection sheet, and collect data from different sources.
Know the advantages of using a pilot study
Know Possible constraints on an investigation and how to deal with difficulties such as non-response.
Know potential problems with collected data and how to deal with them.
Know how and why to clean data.
Identify and control extraneous variables.

Higher

Use the Pearson capture-recapture formula to estimate the size of a population and know the assumptions made when using the method
Select a sample stratified by one category and by more than one category
Use the random response method to sensitive questions.
Understand and know when to use control groups.

Year 10 – Autumn: Processing and representing data

Foundation

Select the appropriate representation to use
Decide whether to group data into class intervals.
Recognise well presented and poorly presented data.
Construct draw and understand
Two-way tables
tally charts
pictograms
Bar charts
vertical line graphs
Stem and leaf diagrams
Pie charts
population pyramids
Choropleth maps
Cumulative frequency graphs
Histograms
Frequency polygons

Higher

Construct draw and understand
Comparative pie charts
Histograms with unequal class widths

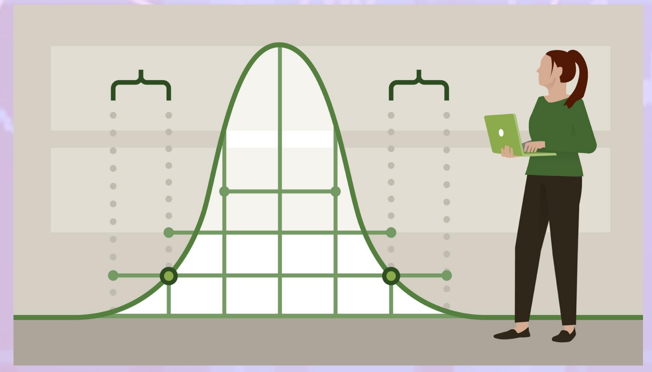
Year 10 – Spring: Summarising data

Foundation

Calculate
The mean, mode, median (including by interpolation) and range for a list of numbers, and discrete and/or continuous data listed in a table.
The minimum, lower quartile, median, upper quartile and maximum value of a list of numbers
The interquartile range and the percentiles of a set of data.
Understand the advantages and disadvantages of each of the three measures of central tendency, and which is appropriate to use in different situations.
Understand the effect of transformations on the mean, mode and median.
Construct, use and interpret box plots from summary statistics and cumulative frequency graphs.
Identify and interpret outliers by inspection and show them on box plots.
Use box plots as a method to compare sets of data for dispersion, measures of central tendency and skewness.
Given the median and interquartile range, make comparisons between different data samples to compare the sample and population data.
Identify simple properties of the shape of distributions of data including symmetry, positive and negative skew.

Higher

Calculate estimates of the median and mean from grouped data with unequal class widths and histograms.
Calculate a geometric mean from a set of data
Calculate a weighted mean from a set of data
Calculate the interpercentile and interdecile range
Calculate the standard deviation of a set of discrete data.
Calculate and estimate for the standard deviation of a set of grouped data.
Identify outliers by calculation.
Determines skewness by calculation.



Year 10 – Summer: Scatter diagrams and correlation

Foundation

Draw a scatter graph
Describe and make comparisons of correlations
Positive, negative or zero
Strong or weak
Understand what is meant by a causal relationship and that correlation does not imply causation
Draw a line of best fit by eye and by drawing through the mean point.
Use a line of best fit to make predictions within and outside the data range.
Understand and comment on the reliability of values found through interpolation and extrapolation.
Interpret Spearman's rank coefficient.

Higher

Find the equation of a line of best fit
Draw a regression line on a scatter, given the equation
Interpret the value of the gradient of a regression line.
Calculate Spearman's rank correlation coefficient.
Interpret Pearsons's product-moment correlation coefficient.
Understand the distinction between Spearman's rank correlation coefficient and Pearson's product-moment coefficient.

Year 10 – Summer: Time series

Foundation

Draw and interpret line graphs and time series.
Draw trend lines on a time series graph and use inspection to identify trends.
Know that a trend line shows the general trend of data.
Interpret rising, falling and level trends on a time series graph.
Identify seasonal variation on a time series graph.
Calculate the four point moving average.
Draw a trend line through moving averages by eye.

Higher

Calculate the estimated mean seasonal variation
Know that the predicted value =trend line + seasonal variation

Year 11 – Autumn: Probability

Foundation

Understand the meaning of the words impossible, certain, very likely, likely, unlikely, possible and evens.
Use fractions, decimals and decimals and percentages to represent probabilities.
Use probability values to calculate expected frequencies and compare them with actual frequencies.
Use probability to assess risk.
Use sample space diagrams, Venn diagrams and tree diagrams to represent all the different outcomes possible for up to three events.
Understand the terms mutually exclusive and exhaustive
Use the addition law P(A or B) = P(A) + P(B) for two mutually exclusive events
Understand what it means b for two events to be independent events.
Use the multiplication laws for independent events.
Understand what it means for two events to be conditional
Calculate conditional probability using a tree diagram, two-way table or venn diagram.
Use the formula for conditional probability.
Know that for independent events A and B, P(A) = P(A/B)

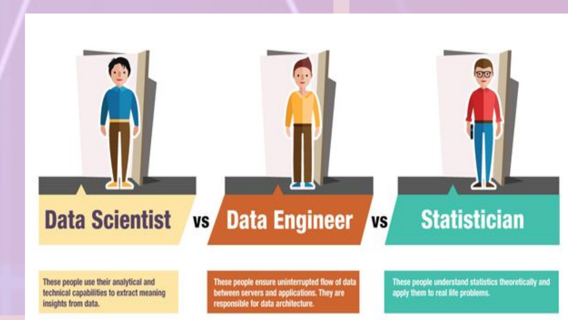
Higher

Use the general addition law of events that are not mutually exclusive

Year 11 – Autumn: Probability Distributions

Higher

Know the conditions for a Binomial distribution to be a suitable model.
Understand the notation B(*n.p*)
Calculate probabilities using the binomial distribution
Know the mean of a \binomial distribution is *np*
Know the conditions for a normal distribution to be a suitable model.
Understand the notation (XX)
Know the shape of a normal distribution curve and how this occurs.
Know that 68% of data lies within one standard deviation of the mean, 95% of data lies within two standard deviations of the mean and 99.8% lies within three standard deviations of the mean.
Draw normal distribution curves, including two curves on the same graph.
Use standardised scores to compare two samples of data.
Understand the process of quality assurance and why it is necessary in the real world.
Calculate warning limits and action limits for means
Draw warning limits and action limits on a control chart for means, medians or ranges.
Understand how warning limits and action limits are used in the manufacturing process.



Year 11 – Spring: Index Numbers

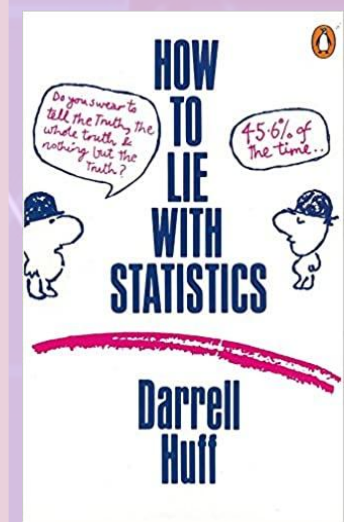
Foundation

Calculate index numbers
Interpret index numbers, including retail price index (RPI) and consumer price index (CPI)
Interpret GDP values
Calculate the rate of change over time, including crude birth and death rates

Higher

Calculate standardised birth and death rates
Calculate and interpret weighted index numbers.
Calculate chain base index numbers.

Revision



Concepts

Collection of data: Data is crucial to the way our lives work - From communicating with friends to how we develop and trial new medicines. Statistics is all about using data to find answers to questions. Without data, there would be no statistics. The first step in any statistical investigation is to pose the question. What are we trying to find out and what data will help you find the answer?

Processing and representing data: It often isn't possible to spot patterns just by looking at raw data, especially larger sets. Careful processing of data can remove errors and appropriate representation can make the spotting of patterns easier, supporting the drawing of appropriate conclusions. The correct selection of charts or diagrams will also make the data more accessible to a wider audience.

Summarising data: Why do people collect data? To draw conclusions. Analysing events that have already happened can give you a good idea of what may happen in the future. For example, a government agency can predict the likelihood of criminal activity in a particular area by analysing the frequency of previous crimes, assisting in the allocation of resources. Analysing and summarising data can help you see the bigger picture and make decisions for the future.

Scatter diagrams and correlation: If you walk or climb a mountain you will find it gets colder as you get higher. There is a relationship or correlation between the height above sea level and the air temperature. You can use Scatter diagrams and measures of correlation to investigate this relationship. To investigate cause and effect and predict values that have not been measured

Time series: Statisticians often look at patterns and behaviours over time. To understand climate change scientists look back at evidence stretching back over a long time period. Using evidence from multiple sources they are then able to estimate historical temperature, identify long term trends and make informed predictions of the future. The same process can use shorter-term data to look at fluctuations in seasonal events and isolate and identify longer-term trends where they exist.

Probability: Do you know your chance of winning a game of chance? Will your train arrive on time? Will it rain today? Statisticians can predict what is likely to happen in games and other events using probability. They also look at more serious issues, such as predicting potential health problems based on genetics or the likely demand for medical services in a particular area of the country.

Probability Distributions: Factory managers know that if machinery breaks down it can cause major disruption. The binomial distribution can help them to calculate the chances of breakdown and plan accordingly. When you buy a packet of crisps you expect them to contain the correct weight. How can a manufacturer make sure that they are all correct without weighing every single packet? Instead, they use sampling and control charts ti ensure that production remains within acceptable tolerances.

Index Numbers: The population of every country is constantly changing. Not just in size but in age gender ethnicity and geographic distribution as well. The same is true of the financial world, with average incomes and cost of living fluctuating all the time. Statisticians use index numbers and rates of change formulae to make sense of our ever-changing world.

"There are three types of lies -- lies, damn lies, and statistics."— **Benjamin Disraeli**

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