

 **Alcester Academy Curriculum Planning: Key Stage 4 (Years 9-11)**

Department: Mathematics		Year Group: 9 to 11		STATISTICS & FURTHER MATHS			
Term	Topic/ subject	Assessment Objectives	Knowledge acquisition	Skill building	Wider reading opportunities to include numeracy and SMSC	Final assessment task and title	SEND & PP
Autumn year 1	1. The collection of data 2. Processing, representing and analysing data	1(a) Planning 1(b) Types of data 1(c) Population and sampling 2(h) Estimation 1(d) Collecting data 2(a) Tabulation and diagrams 2(a) Representing data	Knowledge acquisition will be developed through the building of prior knowledge, revisiting skills covered, and through regular quick fire assessments throughout the term.	The collection of data 1(a) Planning Hypotheses Designing investigations Strategies to deal with potential problems 1(b) Types of data Describing data Raw data, quantitative, qualitative, categorical, ordinal, discrete, continuous, ungrouped, grouped, bivariate and multivariate Advantages and implications of merging/grouping data Primary/secondary data Advantages and disadvantages 1(c) Population and sampling Population, sample frame and sample Judgment, opportunity (convenience) and quota sampling Random, systematic and quota sampling Advantages of each method Techniques to avoid bias Stratified sampling	Bias and the implications of media bias can be introduced. The UK census allows students to develop an awareness of the wider culture. Internet research can lead to discovery of statistical facts and figures used in every day life for instance the recent covid experiences with the ways in which the data can be represented or misrepresented. Use of key words : Sample, population, fraction, decimal, percentage, bias, stratified sample, random, cumulative frequency, box plot, histogram, frequency density, frequency, mean, median, mode, range, lower quartile, upper quartile,	October end of half term assessment – covers content studied only December end of term assessment – covers content studied only	High levels of maths knowledge are a prerequisite for this course, however students will have opportunities for stretch and challenge in every area covered through higher tier only elements of the course such as Unequal width Histograms, Geometric mean and weighted mean, skewness, Standard deviation, Spearman's rank, types of distribution and Price indexes.

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				<p>2(h) Estimation</p> <p>Use summary statistics to make estimates of population characteristics</p> <p>Use sample data to predict population proportions</p> <p>Know that sample size has an impact on reliability and replication</p> <p>Apply Petersen capture recapture formula to calculate an estimate of the size of a population</p> <p>1(d) Collecting data</p> <p>Collection of data</p> <p>Experimental (laboratory, field and natural), simulation, questionnaires, observation, reference, census, population and sampling</p> <p>Reliability and validity</p> <p>Collecting sensitive content matter</p> <p>Random response</p> <p>Questionnaires and interviews</p> <p>Leading questions, avoiding biased sources, time factors, open/closed questions, different types of interview technique</p> <p>Problems with collected data</p> <p>Missing data, non-response, 'cleaning' data</p> <p>Controlling extraneous variables</p> <p>Control groups</p> <p>2. Processing, representing and analysing data</p> <p>2(a) Tabulation</p> <p>Tally, tabulation, two-way tables</p> <p>Frequency tables</p> <p>2(a) Representing data</p> <p>Pictogram</p>	<p>interquartile range, spread, comparison, outlier</p>		
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				<p>Bar charts</p> <p>Pie chart</p> <p>Stem and leaf diagram</p> <p>Population pyramid</p> <p>Choropleth map</p> <p>Comparative pie chart</p> <p>Comparative 2D representations/comparative 3D representations.</p> <p>Interpret and compare data sets represented pictorially</p> <p>Line graphs</p> <p>Bar line (vertical line) charts</p> <p>Frequency polygons</p> <p>Cumulative frequency (discrete and grouped) charts</p> <p>Histograms (equal class width)</p> <p>Box plots</p> <p>Interpret and compare data sets represented graphically</p> <p>Histograms unequal class widths</p> <p style="padding-left: 40px;">Frequency density</p> <p style="padding-left: 40px;">Interpret and compare data sets displayed in histograms</p> <p>2(a) Representing data</p> <p>Justify appropriate form to represent data</p> <p>Graphical misrepresentation</p> <p>Determine skewness by inspection</p> <p>Interpreting a distribution of data with reference to skewness</p> <p>Calculating skewness</p> <p>Comparing data sets represented in different formats</p>			
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<p>Spring year 1</p>	<p>2. Processing, representing and analysing data</p>	<p>2(b) Measures of central tendency 2(c) Measures of dispersion 2(e) Scatter diagrams and correlation 2(f) Time series</p>	<p>Knowledge acquisition will be developed through the building of prior knowledge, revisiting skills covered, and through regular quick fire assessments throughout the term.</p>	<p>2(b) Measures of central tendency Averages from raw or grouped data Mean, median, mode Weighted mean Geometric mean Justify appropriate average to use in context 2(c) Measures of dispersion Range, quartiles, interquartile range (IQR), percentiles Interpercentile range, interdecile range Standard deviation Identifying outliers by inspection Identifying outliers by calculation Comment on outliers in context Compare data sets using appropriate measure of central tendency and measure of dispersion 2(e) Scatter diagrams and correlation Explanatory (independent) variables and response (dependent) variables Correlation Positive, negative, zero, weak, strong Distinction between correlation and causation Line of best fit Using the regression equation $y = a + bx$ Calculate Spearman's rank correlation coefficient Interpret Spearman's rank in context</p>	<p>Bias and the implications of media bias can be introduced. The UK census allows students to develop an awareness of the wider culture. Internet research can lead to discovery of statistical facts and figures used in every day life for instance the recent covid experiences with the ways in which the data can be represented or misrepresented.</p> <p>Use of key words: Sample, population, fraction, decimal, percentage, bias, stratified sample, random, cumulative frequency, box plot, histogram, frequency density, frequency, mean, median, mode, range, lower quartile, upper quartile, interquartile range, spread, comparison, outlier</p>	<p>February half term assessment – GCSE assessment with only content covered</p> <p>Easter Assessment - GCSE assessment with only content covered</p>	<p>High levels of maths knowledge are a prerequisite for this course, however students will have opportunities for stretch and challenge in every area covered through higher tier only elements of the course such as Unequal width Histograms, Geometric mean and weighted mean, skewness, Standard deviation, Spearman's rank, types of distribution and Price indexes.</p>

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				<p>Interpret Pearson's product moment correlation coefficient (PMCC) in context</p> <p>Understand the distinction between Spearman's rank correlation coefficient and Pearson's product moment correlation coefficient (PMCC)</p> <p>2(f) Time series</p> <p>Moving averages</p> <p>Identifying trends</p> <p>Interpreting seasonal and cyclical trends in context</p> <p>Mean seasonal variation</p> <p>Predictions using average seasonal effect</p>			
<p>Summer year 1</p>	<p>3. Probability</p>	<p>3. Experimental and theoretical probability</p> <p>2(d) Further summary statistics</p>	<p>Knowledge acquisition will be developed through the building of prior knowledge, revisiting skills covered, and through regular quick fire assessments throughout the term.</p>	<p>3. Probability</p> <p>3. Experimental and theoretical probability</p> <p>Likelihood</p> <p>Expected frequency of a specified characteristic within a sample or population</p> <p>Use collected data and calculated probabilities to determine and interpret risk</p> <p>Compare experimental data with theoretical predictions</p> <p>Understand that increasing sample size generally leads to better estimates of probability and population parameters.</p> <p>Use two-way tables, sample space diagrams, tree diagrams and Venn diagrams to represent all the different outcomes possible for at most three events.</p> <p>Independent events</p> <p>Conditional probability</p> <p>Difference in terms of bias</p>	<p>Through exploring probability students will develop an awareness of fairness both in a mathematical; context and in real-life scenarios. Use of key words: Probability, dependent, independent, conditional, tree diagrams, sample space, outcomes, theoretical, relative frequency, fairness, experimental</p>	<p>Summer assessment - GCSE assessment with only content covered</p>	<p>High levels of maths knowledge are a prerequisite for this course, however students will have opportunities for stretch and challenge in every area covered through higher tier only elements of the course such as Unequal width Histograms, Geometric mean and weighted mean, skewness, Standard deviation, Spearman's rank, types of distribution and Price indexes.</p>

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<p>Autumn year 2</p>	<p>2. Processing, representing and analysing data</p>	<p>2(c) Standardised scores 2(g) Quality assurance 3. Probability distributions Revision – GCSE Statistics</p>	<p>Knowledge acquisition will be developed through the building of prior knowledge, revisiting skills covered, and through regular quick fire assessments throughout the term.</p>	<p>2(d) Further summary statistics Index numbers / weighted index numbers Retail price index (RPI) Consumer price index (CPI) Gross domestic product (GDP) Interpret data related to rates of change over time when given in graphical form Calculate and interpret rates of change over time from tables using context specific formula 3. Probability distributions Binomial distribution Notation $B(n, p)$ Conditions that make binomial model suitable Mean (np) Calculation of binomial probabilities Normal distribution Notation $N(\mu, \sigma^2)$ Characteristics of Normal distribution Conditions that make Normal model suitable Approximately 95% of the data lie within two standard deviations of the mean and that 68% (just over two thirds) lie within one standard deviation of the mean 2(c) Measures of dispersion Standardised scores 2(g) Quality assurance</p>	<p>Use of all previous key words and terminology.</p>	<p>October end of half term assessment – Full GCSE Statistics paper. December end of term assessment – just covering topics covered in Further Maths</p>	<p>High levels of maths knowledge are a prerequisite for this course, however students will have opportunities for stretch and challenge in every area covered through higher tier only elements of the course such as Unequal width Histograms, Geometric mean and weighted mean, skewness, Standard deviation, Spearman's rank, types of distribution and Price indexes. All topics in Further Maths extend beyond the GCSE Maths course.</p>
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	Further maths crossover elements with GCSE maths	<p>Basic Number</p> <p>Basic Algebra</p> <p>Basic Geometry</p> <p>Algebraic Fractions</p>	<p>Know that a set of sample means are more closely distributed than individual values from the same population.</p> <p>Control charts</p> <p>Use action and warning lines in quality assurance sampling applications.</p> <p>Revision for Paper 1 and Paper 2</p> <p>understand and use the correct hierarchy of operations</p> <p>understand and use ratio and proportion</p> <p>understand and use numbers in index form and standard form</p> <p>understand rounding and give answers to an appropriate degree of accuracy</p> <p>know and understand that if there are x ways to do task 1 and y ways to do task 2, then there are xy ways to do both tasks in sequence</p> <p>understand and use commutative, associative and distributive laws</p> <p>understand and use the hierarchy of operations</p> <p>recall and apply knowledge of the basic processes of algebra, extending to more complex expressions, equations, formulae and identities</p> <p>expand two or more brackets</p> <p>simplify expressions by collecting like terms</p> <p>expand and simplify $(a + b)^n$ for positive integer n</p> <p>work out a particular coefficient of a term in the expansion of $(a + b)^n$ for positive integer n</p> <p>factorise by taking out common factors from expressions</p> <p>factorise expressions given in the form of a quadratic</p> <p>factorise a difference of two squares</p> <p>understand perimeter</p> <p>recall and use the formula for area of a rectangle</p>			
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				<p>recall and use the formula $\times \text{base} \times \text{height}$ for area of a triangle use the formula $\frac{1}{2}ab \sin C$ for area of a triangle recall and use formulae for circumference and area of a circle recall and use formulae for volume of a cube, a cuboid, prisms and pyramids use formulae for volume of a cone and of a sphere understand and use angle properties of parallel and intersecting lines understand and use angle properties of triangles and special types of quadrilaterals and polygons understand and use circle theorems construct formal proofs using correct mathematical notation and vocabulary understand and use the formulae for sine rule and cosine rule use a combination of the skills required in order to manipulate and simplify rational algebraic expressions</p>			
Spring year 2	Further maths crossover elements with GCSE maths	Manipulation and proof Linear and Quadratic equations.	Knowledge acquisition will be developed through the building of prior knowledge, revisiting skills covered, and through regular quick fire assessments throughout the term.	<p>change the subject of a formula, where the subject appears on one or both sides of the formula manipulate formulae and expressions show how one side of an identity can be manipulated to obtain the other side of the identity show that an expression can be manipulated into another given form prove given conditions for algebraic expressions complete the square for any quadratic function of the form $ax^2 + bx + c$ where a, b and c are integers solve quadratic equations by completing the square equate coefficients to obtain unknown values solve linear equations solve quadratic equations by factorisation, by graph, by completing the square or by formula</p>		<p>February half term GCSE Further Maths assessment with only content covered.</p> <p>Easter – Full GCSE Statistics paper.</p>	High levels of maths knowledge are a prerequisite for this course, however students will have opportunities for stretch and challenge in every area covered through higher tier only elements of the course such as Unequal width Histograms, Geometric mean and weighted mean, skewness, Standard deviation, Spearman's rank, types of distribution and Price indexes. All topics in Further

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	Revision of GCSE Statistics			All topics reviewed in preparation for external examination in GCSE Statistics.			Maths extend beyond the GCSE Maths course.
Summer year 2	Revision	Revision	Knowledge acquisition will be developed through the building of prior knowledge, revisiting skills covered, and through regular quick fire assessments throughout the term.	Revision of GCSE Statistics through exam paper practice and recapping of topics.	Use of all previous key words and terminology from the GCSE Statistics elements of this course.	External examination – GCSE Statistics	High levels of maths knowledge are a prerequisite for this course, however students will have opportunities for stretch and challenge in every area covered through higher tier only elements of the course such as Unequal width Histograms, Geometric mean and weighted mean, skewness, Standard deviation, Spearman's rank, types of distribution and Price indexes.
Autumn year 3	Further Maths – introducing extension topics and new topics beyond the GCSE mathematics course.	Coordinate geometry Introductory Calculus Functions Sketching inequalities and functions Surds Rules of indices Equations of lines and circles Simultaneous equations Matrices	Knowledge acquisition will be developed through the building of prior knowledge, revisiting skills covered, and through regular quick fire assessments throughout the term.	work out the gradient of a line given two points on the line select two points on a given line to work out the gradient use the gradient of a line and a known point on the line to work out the co-ordinates of a different point on the line work out the gradients of lines that are parallel and perpendicular to a given line show that two lines are parallel or perpendicular using gradients recall the formula or use a sketch diagram to obtain the appropriate lengths of sides use the formula for the coordinates of the midpoint use a given ratio to work out coordinates of a point given two other points understand and use the notation $\frac{dy}{dx}$	The concept of the inappropriate solution. Use of key words : Quadratic, solution, root, linear, solve, simultaneous, inequality, completing the square, factorise, rearrange, surd, function, solve, circle, sets, union, intersection Know that the quadratic formula can be used to solve	October half term GCSE Further Maths assessment with only content covered. December end of term assessment - GCSE Further Maths covers content studied only	High levels of maths knowledge are a prerequisite for this course, however students will have opportunities for stretch and challenge in all topics in Further Maths extending beyond the GCSE Maths course.

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			<p>understand the concept of the gradient of a curve understand the concept of a rate of change work out gradients of curves and rates of change understand the concept of the gradient of a curve state the gradient of a curve at a point given the gradient or equation of the tangent at that point state the gradient of the tangent at a point given the gradient of the curve at that point work out gradients of curves and tangents find dy/dx, where $y = kx^n$ where k is a constant and n is an integer (including 0) simplify expressions before differentiating if necessary understand that a function is a relation between two sets of values understand and use function notation, for example $f(x)$ substitute values into a function, knowing that, for example $f(2)$ is the value of the function when $x = 2$ solve equations that use function notation define the domain of a function work out the range of a function express a domain in a variety of forms, for example $x > 2$, for all x except $x = 0$, for all real values express a range in a variety of forms, for example $f(x) \leq 0$, for all $f(x)$ except $f(x) = 1$ understand, interpret and use composite function $fg(x)$ understand, interpret and use inverse function $f^{-1}(x)$ draw or sketch graphs of linear, quadratic and exponential functions with up to 3 domains label points of intersection of graphs with the axes understand that graphs should only be drawn within the given domain identify any symmetries on a quadratic graph and from this determine the coordinates of the turning point solve linear inequalities</p>	<p>quadratic equations, and often provides a more efficient method than factorising or completing the square. Know that Matrices can be used within computer programming to produce motion on screen through transformations</p>		
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				<p>solve quadratic inequalities</p> <p>simplify expressions by manipulating surds</p> <p>expand brackets which contain surds</p> <p>rationalise the denominator, including denominators in the form $a\sqrt{b} + c\sqrt{d}$ where a, b, c and d are integers</p> <p>understand the concept of using surds to give an exact answer</p> <p>simplify expressions involving fractional and negative indices which may be written in a variety of forms</p> <p>solve equations involving expressions involving fractional and negative indices</p> <p>understand that, for example $x^{1/n}$ is equivalent to the nth root of x</p> <p>understand that, for example x^{-n} is equivalent to $\frac{1}{x^n}$</p> <p>work out the gradient and the intercepts with the axes of a given equation or graph</p> <p>work out the equation of a line using the gradient and a known point on the line</p> <p>work out the equation of a line using two known points on the line</p> <p>give equations in a particular form when instructed to do so</p> <p>work out coordinates of the point of intersection of two lines</p> <p>draw a straight line using a given gradient and a given point on the line</p> <p>draw a straight line using two given points on the line</p> <p>recognise the equation of a circle, centre $(0, 0)$, radius r</p> <p>write down the equation of a circle given centre $(0, 0)$ and radius</p> <p>work out coordinates of points of intersection of a given circle and a given straight line</p> <p>recognise the equation of a circle, centre (a, b), radius r</p> <p>write down the equation of a circle given centre (a, b) and radius</p> <p>work out coordinates of points of intersection of a given circle and a given straight line</p>			
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				<p>understand that the circle $(x - a)^2 + (y - b)^2 = r^2$ is a translation of the circle $x^2 + y^2 = r^2$ by the vector $\begin{pmatrix} a \\ b \end{pmatrix}$</p> <p>use the fact that the angle between the tangent and radius is 90° to work out the gradient of a tangent and hence the equation of a tangent at a given point</p> <p>solve two linear simultaneous equations using any valid method</p> <p>solve simultaneous equations where one is linear and one is second order using substitution or any other valid method</p> <p>solve three linear simultaneous equations using any valid algebraic method</p> <p>multiply a 2×2 matrix by a 2×1 matrix</p> <p>multiply a 2×2 matrix by a 2×2 matrix</p> <p>multiply 2×2 and 2×1 matrices by a scalar</p> <p>understand that, in general, matrix multiplication is not commutative</p> <p>understand that matrix multiplication is associative</p> <p>understand that $AI = IA = A$</p> <p>work out the image of any vertex of the unit square given the matrix operator</p> <p>work out or recall the matrix operator for a given transformation</p> <p>understand that the matrix product PQ represents the transformation with matrix Q followed by the transformation with matrix P</p> <p>work out the matrix which represents a combined transformation</p>			
Spring year 3	Further Maths - introducing extension topics and new topics beyond the GCSE mathematics course	Trigonometry and Pythagoras Applications of calculus Sequences Factor Theorem Further Trigonometry	Knowledge acquisition will be developed through the building of prior knowledge, revisiting skills covered, and through regular quick fire assessments throughout the term.	<p>work out any unknown side using two given sides</p> <p>identify appropriate right-angled triangles in 2 and 3 dimensional shapes and apply Pythagoras' theorem</p> <p>recognise and use Pythagorean triples</p> <p>identify appropriate right-angled triangles in 2 and 3 dimensional shapes and apply Pythagoras' theorem</p> <p>identify appropriate triangles in 2 and 3 dimensional shapes and apply trigonometry</p> <p>work out the angle between a line and a plane</p>	Mathematics applied in different cultures such as Rangoli patterns, symmetry, tessellations and Islamic geometric patterns. Link to Ben Heine, Kandinsky (artists) Use of key words : Triangle, right angle, angle, Pythagoras' Theorem, sine,	February half term - Full GCSE Further Maths paper. Easter - Full GCSE Further Maths paper	High levels of maths knowledge are a prerequisite for this course, however students will have opportunities for stretch and challenge in all topics in Further Maths extending beyond the GCSE Maths course.

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	Revision	Revision		<p>work out the angle between two planes understand and use bearings recall or work out the exact values of the trigonometric ratios for angles 30°, 45° and 60° work out the equation of a tangent to a curve work out the equation of a normal to a curve understand that stationary points are points at which the gradient is zero work out stationary points on a curve understand and use the fact that when the gradient of a function is positive, the function is increasing understand and use the fact that when the gradient of a function is negative, the function is decreasing work out the second derivative understand that maxima and minima points are points at which the gradient is zero work out maxima and minima points on a curve prove whether a point at which the gradient is zero is a maximum or minimum point using either increasing/decreasing functions or d^2y/dx^2 use mensuration formulae to obtain expressions for perimeters, areas or volumes work out maxima and minima draw a sketch graph of a curve work out the maximum and/or minimum points write down the value of the nth term of a sequence for any given value of n work out the limiting value for a given sequence or for a given nth term as n approaches infinity write down the value of the nth term of a linear sequence for any given value of n work out the nth term of a given linear sequence write down the value of the nth term of a quadratic sequence for any given value of n work out the nth term of a given quadratic sequence understand and use the factor theorem to factorise polynomials</p>	<p>cosine, tan, trigonometry, opposite, hypotenuse, adjacent, ratio, elevation, depression, length, accuracy</p>		
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				<p>find rational roots of polynomial equations show that $(ax - b)$ is a factor of the function $f(x)$ by checking that $f(b/a) = 0$ solve polynomial equations understand and use the properties of the graphs of $y = \sin x$, $y = \cos x$ and $y = \tan x$ for angles of any size sketch and use the graphs to solve problems recall the sign of $\sin \theta$, $\cos \theta$ and $\tan \theta$ for any positive angle up to 360° understand and use the relationships between positive angles up to 360° (eg, $\sin(180 - \theta) = \sin \theta$) use the identities to simplify expressions use the identities to prove other identities use the identities in solution of equations work out all solutions in a given interval rearrange equations including the use of the identities use factorisation</p>			
Summer year 3	Revision	Revision	<p>Knowledge acquisition will be developed through the building of prior knowledge, revisiting skills covered, and through regular quick fire assessments throughout the term.</p>	<p>Review of all of the above content in preparation for the final examination.</p>	<p>All previous key words through revision and topic review.</p>	<p>External examination – GCSE Further Maths</p>	<p>High levels of maths knowledge are a prerequisite for this course, however students will have opportunities for stretch and challenge in all topics in Further Maths extending beyond the GCSE Maths course.</p>