KS3 Progression Map: Probability and Statistics

This progression map expands upon the statements of subject content in the DfE document *Mathematics programmes of study: Key Stage 3* published September 2013. Suggested allocation of material to Years 7, 8 and 9 is given as starting points for writing schemes of work, but the implicit chronology is not intended to be prescriptive or restrictive; indeed, the programme of study is explicit that "Decisions about progression should be based on the security of pupils' understanding and their readiness to progress to the next stage. Pupils who grasp concepts rapidly should be challenged through being offered rich and sophisticated problems before any acceleration through new content in preparation for key stage 4. Those who are not sufficiently fluent should consolidate their understanding, including through additional practice, before moving on". The NCETM fully endorses these principles, and will be developing further this progression map to help teachers achieve them.

Furthermore, although the map is organised by content, this is only for ease of reference and use. In the classroom, links between topics on the map, and between different maps, should be looked for and explored at every opportunity, so that "by the end of Key Stage 3, pupils … know, apply and understand the matters, skills and processes specified". Throughout Y7-9 pupils should have regular and opportunity and developmental feedback that helps them to **develop fluency**, to

- consolidate their numerical and mathematical capability from Key Stage 2 and extend their understanding of the number system and place value to include decimals, fractions, powers and roots
- select and use appropriate calculation strategies to solve increasingly complex problems
- move freely between different numerical, algebraic, graphical and diagrammatic representations [for example, equivalent fractions, fractions and decimals, and equations and graphs]

- use language and properties precisely to analyse numbers, algebraic expressions, 2-D and 3-D shapes, probability and statistics;

to **reason mathematically**, to

- extend their understanding of the number system; make connections between number relationships, and their algebraic and graphical representations

- extend and formalise their knowledge of ratio and proportion in working with measures and geometry, and in formulating proportional relations algebraically

- make and test conjectures about patterns and relationships; look for proofs or counter-examples

- begin to reason deductively in geometry, number and algebra, including using geometrical constructions

- interpret when the structure of a numerical problem requires additive, multiplicative or proportional reasoning

- explore what can and cannot be inferred in statistical and probabilistic settings, and begin to express their arguments formally;

and to **solve problems**, to

- develop their mathematical knowledge, in part through solving problems and evaluating the outcomes, including multi-step problems

- develop their use of formal mathematical knowledge to interpret and solve problems, including in financial mathematics

- begin to model situations mathematically and express the results using a range of formal mathematical representations

- select appropriate concepts, methods and techniques to apply to unfamiliar and non-routine problems.

The NCETM will be developing further resources to support the development and embedding of these skills.

Probability

Year 7	Year 8	Year 9
record and describe the frequency of outcomes of simple probability experiments; try to explain their findings using their own ideas about randomness and possible outcomes; make and explain their own judgments about the fairness of situations; understand that the probability of an impossible event is 0, and of a certain event is 1, and begin to use the 0-1 probability scale	record and describe the frequency of outcomes of simple probability experiments; in the light of experience begin to refine their own ideas about causal connections between aspects of experiments that involve randomness and equally and unequally likely outcomes and the properties of data distributions; make better informed judgments about the fairness of situations; begin to allocate probabilities to particular outcomes by considering all possible outcomes	record, describe and analyse the frequency of outcomes of simple probability experiments involving randomness, fairness, equally and unequally likely outcomes, using appropriate language and the 0-1 probability scale; begin to notice the same patterns in different situations
	understand why, when there are only two possible outcomes, the probabilities of the two possible outcomes sum to 1	understand that the probabilities of all possible outcomes sum to 1
enumerate sets systematically, devising their own diagrams	enumerate sets systematically making use of tables and grids	enumerate sets and unions/intersections of sets systematically, using tables, grids and Venn diagrams
		generate theoretical sample spaces for single and combined events with equally likely, mutually exclusive outcomes and use these to calculate theoretical probabilities.

Statistics

Year 7	Year 8	Year 9
describe, interpret and compare observed distributions of a single variable through: appropriate graphical representation involving discrete, including grouped, data; and appropriate measures of central tendency (mean, mode, median) and spread (range)	describe, interpret and compare observed distributions of a single variable through: appropriate graphical representation involving discrete, continuous and grouped data; and appropriate measures of central tendency (mean, mode, median) and spread (range)	describe, interpret and compare observed distributions of a single variable through: appropriate graphical representation involving discrete, continuous and grouped, data; and appropriate measures of central tendency (mean, mode, median) and spread (range, consideration of outliers)
construct and interpret frequency tables, bar charts, pie charts, and pictograms for simple categorical data, and vertical line (or bar) charts for small sets of ungrouped numerical data and numerical data grouped into a small number of groups	construct and interpret frequency tables, bar charts, pie charts, and pictograms for larger sets of categorical data, and vertical line (or bar) charts for larger sets of ungrouped and grouped numerical data	construct and interpret appropriate tables, charts, and diagrams, including frequency tables, bar charts, pie charts, and pictograms for categorical data, and vertical line (or bar) charts for ungrouped and grouped numerical data
describe mathematical relationships between two variables that are easily visible in the data derived from experiments or observations	describe simple mathematical relationships between two variables that can be seen in the data derived from students' own experiments or observations	describe simple mathematical relationships between two variables (bivariate data) in observational and experimental contexts
	represent bivariate data on a scatter graph	use a scatter graph to illustrate simple mathematical relationships between two variables