

# Quantitative Problem Solving (MEI) – Resources



**L3 CERTIFICATE**

# Component 01 - Introduction to Quantitative Reasoning- CONTENT

# USE OF TECHNOLOGY

## Spreadsheets

	Content	Notes	Resources
q2	Be able to read information from a standard spreadsheet.		Integral Resources - OCR (MEI) Level 3 IQR: <a href="#">Reference: Spreadsheets 1 – formulae</a> <a href="#">Reference: Spreadsheets 2 – graphs</a>
q3	Be able to enter formulae and data into a spreadsheet, knowing that a standard spreadsheet formula starts with =.	Formulae based on the 4 rules of arithmetic and other standard functions required by the rest of this specification, e.g. to the power of, square root.  e.g. =B2*(C2+D2) =C3^4 =SQRT(A10)	MEI Free Resources – Integrating Mathematical Problem Solving: The mathematics for business and science: <a href="#">Student loans 1</a> <a href="#">Student loans 2</a>
q4	Be able to interpret simple formulae on a spreadsheet given in terms of cell references.	Examples include money, number patterns and simple sequences.  e.g. =AVERAGE(A1:A9)	External Resources: <a href="#">Finding Averages Using Excel</a>  <a href="#">Using Excel For Simple Data Analysis</a>
q5	Be able to copy a formula and to ensure that only the required cell addresses increment.	e.g. \$A1, \$A\$1, A\$1	<a href="#">Exponential growth</a>  <a href="#">Compound interest</a>
q6	Be able to use a spreadsheet to find a numerical solution of an equation.	Equations in one variable, involving powers and/or roots using trial and improvement.	<a href="#">How Much Does It Cost to be Cool?</a>
q7	Be able to use a spreadsheet to draw graphs and standard statistical diagrams and interpret graphs produced on spreadsheets.	Including awareness of when graphs produced by a spreadsheet are misleading or incorrect.	

# MODELLING

## The modelling cycle

	Content	Notes	Resources
p1	Be able to identify simplifying assumptions that allow a situation to be modelled.		Integral Resources - OCR (MEI) Level 3 IQR: <a href="#">Representing the real world mathematically 3: Modelling</a>  MEI Free Resources – Integrating Mathematical Problem Solving: The mathematics of business and finance: <a href="#">Statistical modelling</a>  External Resources: <a href="#">Malthus</a>  <a href="#">Modelling With Spreadsheets - Planning a Festival</a>  <a href="#">Mathematics Assessment Project</a>
p2	Be able to develop or choose a simple mathematical model for a real-world situation.	Model in words, numerically, algebraically, diagrammatically or in a spreadsheet.	
p3	Be able to use a model to make predictions or get information about a situation.	For example, use a simple demand curve (e.g. a linear model) to predict the change in revenue following a given change in price.	
p4	Be able to compare the outcomes from a model with actual data, information, experience or common sense and comment on the appropriateness of the model.	For example, compare an exponential growth model with actual population figures.  The information may be given in diagrammatic or graphical form.	
p5	Be able to appraise the assumptions underlying a model critically.		
p6	Understand that a simple model can give useful answers but may need to be improved.	Includes comparing outcomes from two models.	
p7	Be able to communicate mathematical results clearly and effectively.	Including to a person or audience unfamiliar with the underlying mathematics.	

# MODELLING

## Estimation

	Content	Notes	Resources
e1	Be able to make a rough estimate of a quantity from available information.	This includes financial estimates such as conversion from a foreign currency to pounds without a calculator.	Integral Resources - OCR (MEI) Level 3 IQR: <a href="#">Roughly Speaking</a>
e2	Be able to use estimates when checking calculations.		External Resources: <a href="#">Estimation of population size based on a sample</a>
e3	Be able to make and justify upper and lower bounds for a calculation.	Includes selecting and/or justifying an appropriate level of accuracy for an answer to a calculation.  Maximum, minimum, upper bound, lower bound	<a href="#">Estimation of height from step length</a>  <a href="#">MathsIsFun</a>  <a href="#">Introduction to confidence intervals</a>  <a href="#">Mathematics Assessment Project</a>
e4	Be able to interpret and present error bounds or tolerances on diagrams and in writing, understanding that different levels of tolerance are appropriate in different situations.	Error bounds may be required in percentage form.	

# MODELLING

## Algebra

	Content	Notes	Resources
a1	Be able to represent a situation mathematically using a formula or equation.	Using both traditional algebra and spreadsheet notation.	Integral Resources - OCR (MEI) Level 3 IQR: <a href="#">Representing the real world mathematically 1: Algebra</a>  External Resources: <a href="#">Improving learning in mathematics: mostly algebra</a>  <a href="#">Formulas used in nursing calculations</a>  <a href="#">Mathematics Assessment Project</a>
a2	Be able to substitute values into a formula given in symbols, words or as a flow chart.	Formulae will be confined to the following cases (or simple combinations of these): <ul style="list-style-type: none"> <li>•polynomials</li> <li>•simple rational expressions</li> <li>•exponential growth and decay</li> <li>•trigonometric functions (sin and cos).</li> </ul>	
a3	Be able to solve equations and change the subject of a formula.	In simple cases using the four operations, powers and roots.  Solve more complex equations using trial and improvement or a graphical method.	

# MODELLING

## Geometry & measures

	Content	Notes	Resources
m1	Be able to recognise and use relationships between lengths, areas, weights and volumes of similar figures to model real-world situations.		Integral Resources - OCR (MEI) Level 3 IQR: <a href="#">Measures and scaling 1: 2D and 3D shapes</a>  MEI Free Resources – Integrating Mathematical Problem Solving: The mathematics of chemistry: <a href="#">Concentrations</a> The mathematics of biology: <a href="#">The microscope</a>  External Resources: <a href="#">Nuffield: Costing the Job</a> <a href="#">Nuffield: Points of View</a>  <a href="#">MAP: Developing a Sense of Scale</a> <a href="#">MAP: A Golden Crown</a> <a href="#">MAP: Developing a Sense of Scale</a>  <a href="#">Mathematics Assessment Project</a>
m2	Be able to work with time, length, area and volume to meet given regulations.	e.g. In the context of meeting health and safety requirements. Regulations to be met will be given to learners. e.g. Units of time, speed.	
m3	Be able to work with commonly used units and know that quantities being compared should have the same units; this includes compound units.	e.g. Units of speed are units of distance divided by units of time.  e.g. Understanding that the units of quantities arise from the way they are calculated. Where appropriate, conversion factors between metric and imperial units will be given.	
m4	Be able to interpret diagrams, maps and scale drawings and be able to use them in problem solving.		
m5	Be able to work with representations of 3-D objects in 2-D.	Representations include plans and elevations, sketches and isometric drawings.	
m6	Understand the terms displacement, distance, velocity, speed and acceleration; perform associated calculations.	Displacement as directed distance from a starting point; velocity as directed speed.	

# MODELLING

## Number

	Content	Notes	Resources
n1	Be able to use ratio and proportionality in realistic contexts.		



# STATISTICS

## The statistics cycle

	Content	Notes	Resources
s1	Be able to decide what data need to be collected in order to answer a question requiring statistical evidence.		Integral Resources - OCR (MEI) Level 3 IQR: <a href="#">Statistics 1: Introduction &amp; collecting data</a> <a href="#">Statistics 4: Bringing it all together</a>
s2	Be able to use a suitable method for collecting data, taking ethical considerations into account, and judge whether data are of sufficient quality.	The data may be primary or secondary, and may be read off a graph or diagram.	MEI Free Resources – Integrating Mathematical Problem Solving: The mathematics of business and finance: <a href="#">Statistical modelling</a>
s3	Be able to process and present the data and so provide an answer to the original question.		External Resources: <a href="#">200 countries, 200 years, 4 minutes</a>  <a href="#">KS4 statistics statements: true or false</a>
s4	Be able to interpret the answer to the question and decide whether it is realistic.		<a href="#">Relevant and engaging stats: teaching through statistical investigations</a>  <a href="#">Getting To School!</a>  <a href="#">Sample Handling Data Unit</a>

# STATISTICS

## Data

	Content	Notes	Resources
s5	Understand and use the language describing types of data.	Primary, secondary; categorical, numerical; continuous, discrete.	Integral Resources - OCR (MEI) Level 3 IQR: <a href="#">Statistics 1: Introduction &amp; collecting data</a>
s6	Be able to recognise values in primary or secondary data which are unlikely to be accurate.		External Resources: <a href="#">200 countries, 200 years, 4 minutes</a>
s7	Be able to read information from a table and to construct a table to present information.	Includes grouping data using suitable class intervals.	<a href="#">Relevant and engaging stats: using spreadsheets</a>
s8	Understand the meaning of the terms sample and population.	The idea of random sampling.	<a href="#">KS4 statistics statements: true or false</a> <a href="#">Ugly data visualisation</a> <a href="#">Census at School: graph it!</a>
s9	Be able to interpret sample data in terms of possible properties of the parent population.	e.g. Sample mean as an estimate of population mean.	<a href="#">Relevant and engaging stats: teaching through statistical investigations</a>
s10	Understand about the variability of data and be able to describe the main features of a distribution.	Includes understanding that the average from a sample will generally be different from the population average.  The main features include the central tendency (average) and spread.	<a href="#">Data types resources</a>

# STATISTICS

## Statistical diagrams and measures

	Content	Notes	Resources
s11	Be able to use and interpret statistical diagrams appropriate to a variety of types of data.	<p>Diagrams include: box and whisker plots, dot plots, scatter diagrams, bar charts, pie charts, histograms, frequency charts, cumulative frequency diagrams.</p> <p>Learners may be asked to complete these diagrams in the examination.</p> <p>A frequency chart resembles a histogram with equal width bars but its vertical axis is frequency. A dot plot is similar to a bar chart but with stacks of dots in lines to represent frequency.</p>	<p>Integral Resources - OCR (MEI) Level 3 IQR:  <a href="#">Statistics 2: Statistical techniques</a></p> <p>External Resources:  <a href="#">200 countries, 200 years, 4 minutes</a></p> <p><a href="#">Standards Unit S4 Understanding mean, median, mode and range</a></p> <p><a href="#">Standards Unit S5 Interpreting bar charts, pie charts, box and whisker plots</a></p>
s12	Be able to identify when a statistical diagram is misleading and explain how it could be improved.	e.g. Improvement by clearer labelling or a better scale.	<a href="#">Standards Unit S6 Interpreting frequency graphs, cumulative frequency graphs, box and whisker plots</a>
s13	Be able to identify skewness from a histogram, frequency chart or box and whisker plot.	<p>In appropriate contexts.</p> <p>Positive and negative skewness.</p>	<a href="#">Relevant and engaging stats: teaching through statistical investigations</a>
s14	Be able to interpret a scatter diagram for bivariate data, draw a line of best fit by eye when it is appropriate to do so and understand that extrapolation might not be justified.	Including the terms association, correlation, line of best fit.	<p><a href="#">Graphing U.S. Presidential Elections</a></p> <p><a href="#">How Safe Is My Town?</a></p>

# STATISTICS

## Statistical diagrams and measures

	Content	Notes	Resources
s15	Be able to select and calculate appropriate measures of central tendency and to interpret them.	Mean, median, mode. Includes grouped data and calculation or estimation for data in a statistical diagram.	Integral Resources - OCR (MEI) Level 3 IQR: <a href="#">Statistics 2: Statistical techniques</a>  External Resources: <a href="#">Fundamentals of Statistics 1: Basic Concepts Tutorial</a>  <a href="#">200 countries, 200 years, 4 minutes</a>  <a href="#">Standards Unit S4 Understanding mean, median, mode and range</a>  <a href="#">Relevant and engaging stats: using spreadsheets</a>
s16	Be able to use appropriate measures of spread and to interpret them.	Calculate range, inter-quartile range, semi inter-quartile range. Includes grouped data and calculation or estimation for data in a statistical diagram.  Know that standard deviation is a measure of spread.	<a href="#">KS4 statistics statements: true or false</a>  <a href="#">Ugly data visualisation</a>  <a href="#">Census at School: graph it!</a> <a href="#">Relevant and engaging stats: teaching through statistical investigations</a> <a href="#">To Invest or Not to Invest</a> <a href="#">The Standard Deviation Tutorial</a>
	Be able to calculate a weighted mean and recognise when it is appropriate to do so.		

# STATISTICS

## The Normal distribution

	Content	Notes	Resources
s18	Know that the Normal distribution is a model which can be used for real data and recognise a Normal curve.	Know that the distribution is symmetrical about the mean for the population but understand that histograms for samples will usually not be exactly symmetrical.	Integral Resources - OCR (MEI) Level 3 IQR: <a href="#">Statistics 3: The Normal distribution</a>
s19	Know that, for a Normal distribution, values more than three standard deviations from the mean are very unusual; know that 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.	Learners may be asked to estimate mean and standard deviation from a Normal curve.	MEI Free Resources – Integrating Mathematical Problem Solving: The mathematics of business and finance: <a href="#">Modelling the market (part 1)</a>
s20	Be able to use mean and standard deviation to calculate a z-score and use z-scores for comparison or quality control.	Includes interpreting z-score as number of standard deviations away from the mean.	External Resources: <a href="#">Fundamentals of Statistics 2: The Normal Distribution Tutorial</a>
s21	Be able to interpret a Normal probability plot from statistical software.	A straight line indicates a Normal distribution.	<a href="#">Census at School: Is our height Normal?</a>  <a href="#">Census at School Data Tool</a>

# FINANCE

## The financial cycle

	Content	Notes	Resources
f1	Be able to decide what information is needed to address a financial situation.		Integral Resources - OCR (MEI) Level 3 IQR: <a href="#">Financial problem solving 3: Costing and problem solving</a>
f2	Know how to obtain the necessary information.	The information may be presented in a graph or diagram.	MEI Free Resources – Integrating Mathematical Problem Solving: The mathematics of business and finance: <a href="#">Student loans (part 1)</a> <a href="#">Student loans (part 2)</a> <a href="#">Modelling the market (part 0)</a>
f3	Be able to process the information to provide one or more possible solutions.		External Resources: <a href="#">To Invest or Not to Invest</a>
f4	Be able to decide which, if any, of the solutions are appropriate.		

# FINANCE

## Percentages

	Content	Notes	Resources
f5	Be able to do calculations involving percentages in context; the use of an index number to compare a number or value to that in a base year.	<p>Contexts include those outside finance.</p> <p>Examples of financial contexts include VAT, inflation and compound interest for savings or loans.</p> <p>Expected calculations include forward and reverse percentage increase and decrease, repeated and combined percentage change and finding a percentage change.</p>	<p>Integral Resources - OCR (MEI) Level 3 IQR:  <a href="#">Financial problem solving 1: Working with percentages</a></p> <p>MEI Free Resources – Integrating Mathematical Problem Solving:            The mathematics of business and finance:  <a href="#">Compound interest</a>  <a href="#">Inflation</a>            The mathematics of economics:  <a href="#">Real terms</a></p>
f6	Know how to use percentages to work with appreciation or depreciation.	Including comparison of an annual percentage depreciation (or appreciation) model with actual values over time.	<p>External Resources:  <a href="#">Standards Unit N7 Using percentages to increase quantities</a>  <a href="#">MyMoneyWeek</a>  <a href="#">Forsooth</a>  <a href="#">Car depreciation from what car?</a>  <a href="#">BBC inflation tracker</a>  <a href="#">World Bank inflation rates</a></p>
f7	Be able to work out an average annual percentage growth (or reduction) rate for a given change over a period.	Contexts include those outside finance.	

# FINANCE

## Foreign exchange

	Content	Notes	Resources
f8	Be able to use foreign exchange rate information to make calculations, including calculations for currency exchange with commission or a fee.	In the UK, “sell at 1.54, buy at 1.69” means that when converting from pounds to the currency, a customer gets 1.54 of the currency for £1, but when changing the currency to pounds, 1.69 of the currency is needed for £1.	Integral Resources - OCR (MEI) Level 3 IQR: <a href="#">Financial problem solving 2: Foreign exchange</a>  External Resources: <a href="#">Compare currency exchange rates</a>
f9	Be able to decide which foreign exchange rate is most advantageous for a particular exchange without doing the calculations.	Deciding and justifying which exchange rate is most advantageous to the customer.	



# FINANCE

## Costing

	Content	Notes	Resources
f10	Be able to work out the regular outgoing cost for a financial decision.	Examples include the monthly cost of buying and running a car or renting and running a home.	Integral Resources - OCR (MEI) Level 3 IQR: <a href="#">Financial problem solving 3: Costing and problem solving</a>  MEI Free Resources – Integrating Mathematical Problem Solving: The mathematics of business and finance: <a href="#">Inflation</a>
f11	Be able to find relevant information from tables.		
f12	Be able to use a spreadsheet to cost a project or business proposal, recognising that some costs are more predictable than others over time.	Learners may be asked to monitor whether a budget is being followed over time, and to calculate projected costs from the budget.	
f13	Be able to use a demand curve as a model for the relationship between price and demand.		
f14	Understand and use the language of finance.	Words such as income, expenditure, budget, profit, loss, investment, tax, revenue, inflation, APR and AER.	

# WORKING WITH EXPONENTIALS

## Standard form

	Content	Notes	Resources
I1	Be able to interpret large or small numbers in standard form, including the use of a spreadsheet or calculator.	Standard form is sometimes called scientific notation.	<p>Integral Resources - OCR (MEI) Level 3 IQR: <a href="#">Working with exponentials 1: Standard form</a></p> <p>MEI Free Resources – Integrating Mathematical Problem Solving: The mathematics of chemistry: <a href="#">Moles</a></p>
I2	Be able to calculate with numbers in standard form.	e.g. Contexts such as astronomy, wavelengths, atoms or cells.	<p>External Resources: <a href="#">Improving learning in mathematics: estimating length using standard form</a></p>

# WORKING WITH EXPONENTIALS

## Exponentials

	Content	Notes	Resources
13	Be able to explore exponential growth and decay, including interpreting output from a spreadsheet.	Contexts include borrowing and saving money, bacterial growth and radioactive decay.	Integral Resources - OCR (MEI) Level 3 IQR: <a href="#">Working with exponentials 2: Exponential growth and decay</a>
14	Be able to represent and interpret exponential growth or decay in a graph.	Learners may be asked to plot or sketch exponential graphs.	MEI Free Resources – Integrating Mathematical Problem Solving: The mathematics of biology: <a href="#">Exponential growth</a> The mathematics of business and finance: <a href="#">Compound interest</a>
15	Be able to solve equations of the forms $x^5 = 35$ and $1.05^x = 8.2$ .	Trial and improvement for equations of form $1.05^x = 8.2$ .	External Resources: <a href="#">Phet radioactive dating game</a>  <a href="#">World income distribution</a>  <a href="#">Population Explosion Using an Exponential Function</a>

# WORKING WITH EXPONENTIALS

## Logarithmic scales

	Content	Notes	Resources
16	Be able to use and interpret a logarithmic scale on a graph.	Learners should know that the value equidistant between $a$ and $b$ on a linear scale is the arithmetic mean but for a logarithmic scale it is the geometric mean .	<p>Integral Resources - OCR (MEI) Level 3 IQR: <a href="#">Working with exponentials 3: Logarithmic scales</a></p> <p>MEI Free Resources – Integrating Mathematical Problem Solving: The mathematics of biology: <a href="#">Exponential growth</a> The mathematics of chemistry: <a href="#">pH</a></p> <p>External Resources: <a href="#">Gapminder world</a></p> <p><a href="#">World income distribution</a></p>

# WORKING WITH GRAPHS AND GRADIENTS

## Graphs

	Content	Notes	Resources
g1	Know that the independent variable is plotted on the horizontal axis of a graph.		Integral Resources - OCR (MEI) Level 3 IQR: <a href="#">Representing the real world mathematically 2: Graphs and gradients</a>  MEI Free Resources – Integrating Mathematical Problem Solving: The mathematics of economics: <a href="#">Real terms</a>  External Resources: <a href="#">Improving learning in mathematics: mostly algebra</a>  <a href="#">The moving man</a>
g2	Be able to construct a table of values for a graph from a simple formula and use it to plot the graph.	Includes trigonometric graphs (sin and cos) for angles in degrees.	
g3	Be able to use a graph to construct a table of values.		
g4	Be able to work with graphs drawn from a variety of contexts.	Includes graphs representing motion along a straight line, time series graphs, step graphs, periodic graphs, graphs of exponential growth and decay and piecewise graphs.	
g5	Recognise graphs of direct and inverse proportion.		
g6	Be able to linearise the graph of a relationship where the dependent variable is directly proportional to some function of the independent variable.	e.g. Plot $y$ against $x$ to investigate a relationship of the form $y = kx^n$ .	
g7	Understand the relationship between a straight line graph and the formula connecting the variables graphed.		

# WORKING WITH GRAPHS AND GRADIENTS

## Gradients

	Content	Notes	Resources
g8	Be able to find the gradient of a straight line graph and interpret it in context, taking account of the scales on the axes and using appropriate units.	Includes finding units for the gradient from units on the axes.	Integral Resources - OCR (MEI) Level 3 IQR: <a href="#">Representing the real world mathematically 2: Graphs and gradients</a>
g9	Be able to estimate the gradient of a curve at a point by drawing a tangent and interpret it as a rate of change.	Includes e.g. kinematics graphs and growth curves.	External Resources: <a href="#">Improving learning in mathematics: mostly algebra</a>  <a href="#">The moving man</a>

# RISK

## Probability

	Content	Notes	Resources
u1	Be able to identify relevant equally likely outcomes in appropriate contexts.	Includes understanding when outcomes are not equally likely.	Integral Resources - OCR (MEI) Level 3 IQR: <a href="#">Probability and risk 2: Probability</a> <a href="#">Probability and risk 3: Probability trees</a>  External Resources: <a href="#">Gerd Gigerenzer on risk</a>  <a href="#">Screening tests from</a>  <a href="#">Understanding Uncertainty</a>
u2	Be able to count equally likely outcomes in appropriate contexts and hence estimate a probability.	Includes listing and use of tree diagrams to find number of outcomes.	
u3	Be able to estimate probability from long-run relative frequency.		
u4	Be able to interpret two-way tables and use them to calculate or estimate probability.		
u5	Understand the difference between dependent and independent events and be able to calculate probability in simple cases.	Contexts include games of chance and risk of suffering from diseases.	
u6	Be able to work with a tree diagram when calculating or estimating a probability, including conditional probability.	Learners can choose to work with either frequencies or probabilities in tree diagrams.	

# RISK

## Risk

	Content	Notes	Resources
u7	Understand risk given as a probability or as 1 in $n$ or as a description such as “once in $n$ years”.	Includes moving between these forms.	Integral Resources - OCR (MEI) Level 3 IQR: <a href="#">Probability and risk 1: Risk</a>  External Resources: <a href="#">2845 ways of spinning risk</a>
u8	Be able to interpret a risk assessment, understanding that it involves measures of both likelihood and impact.		<a href="#">Paling perspective scale: a logarithmic scale for risk</a>  <a href="#">How risky is life?</a>



# Component 02 – Statistical Problem Solving- CONTENT

# PROBLEM ANALYSIS

## Strategies for problem solving; Selecting a model; Inputs

	Content	Notes	Resources
s1	Be able to formulate a problem in a way that lends itself to statistical approaches.	There is no exclusive list of problems; they may be drawn from a variety of contexts.	Integral Resources - OCR (MEI) Level 3 SPS: <a href="#">The Problem Solving Cycle - The long and short of it</a> <a href="#">Is this a valid argument?</a>  MEI Free Resources – Integrating Mathematical Problem Solving: The mathematics of psychology: <a href="#">Correlational study</a> <a href="#">Take your partners</a> <a href="#">Music and maths</a>  External Resources: <a href="#">Problem Solving Approach in Statistics resources</a>
s2	Consider different statistical approaches to a problem.	Learners will be expected to make and identify approximations and simplifications that allow them to tackle a problem.	
s3	Be able to select an appropriate standard distribution as a model.	e.g. The Normal distribution or the uniform distribution.	
s4	Recognise where a standard statistical procedure may be used.	e.g. Drawing a line of best fit or using a hypothesis test.	
s5	Be aware of any modelling assumptions involved in using a distribution or procedure that has been selected.		
s6	Be able to identify what inputs a model requires.	This includes identifying and selecting suitable parameters, and collecting relevant data.	
s7	Be able to design a procedure for collecting the necessary input data for a model.		
s8	Understand the sources of variability in data and their implications in the context of a model and its inputs.	Natural variability, experimental error or sampling error.	

# PROBLEM ANALYSIS

## Inference

	Content	Notes	
h1	Understand the process of hypothesis testing, including using the associated vocabulary.	<ul style="list-style-type: none"> <li>• null hypothesis, alternative hypothesis</li> <li>• significance level, p-value</li> <li>• 1-tail test, 2-tail test</li> <li>• critical value</li> <li>• critical region</li> <li>• acceptance region, rejection region.</li> </ul>	<p>Integral Resources - OCR (MEI) Level 3 SPS: <a href="#">Are we equal? - Correlation and Hypothesis Tests</a></p> <p>MEI Free Resources – Integrating Mathematical Problem Solving: The mathematics of psychology: <a href="#">Correlational study</a> <a href="#">Take your partners</a> <a href="#">Music and maths</a></p> <p>The mathematics of biology: <a href="#">Statistical testing in medicine</a></p>
h2	Be aware that large data sets can be representative of underlying populations and can be used to draw conclusions.	<p>Recognising when a large data set is representative of the whole population.</p> <p>e.g. Using visual displays, summary values.</p>	<p>External Resources: <a href="#">IQ Tests - What's Your Hypothesis?</a></p> <p><a href="#">Benford's Law</a></p>

# DATA COLLECTION

## Sampling

	Content	Notes	Resources
s9	Know and be able to use suitable sampling methods in appropriate contexts.	Sampling methods include: <ul style="list-style-type: none"><li>• opportunity sampling</li><li>• simple random sampling</li><li>• stratified sampling</li><li>• quota sampling</li><li>• cluster sampling</li><li>• self-selected sampling.</li></ul>	Integral Resources - OCR (MEI) Level 3 SPS: <a href="#">Money Making Movies - Sampling Methods</a> <a href="#">Experiment Design - Love or football?</a>  External Resources: <a href="#">Populations and samples resources</a>  <a href="#">Non-random sampling resources</a>  <a href="#">Random sampling resources</a>  <a href="#">Fundamentals of Statistics 3: Sampling Tutorial</a>

# DATA COLLECTION

## Information sources

	Content	Notes	Resources
e1	Be able to call on factual general knowledge.		Integral Resources - OCR (MEI) Level 3 SPS: <a href="#">Experiment Design - Love or football?</a> <a href="#">The Problem Solving Cycle - The long and short of it</a> <a href="#">Is this a valid argument?</a>  External Resources: <a href="#">Reliability and validity resources</a>  <a href="#">Graphs in the Media</a>
e2	Be able to make reasonable estimates of quantities met in everyday life without additional information.	Quantities such as the following: <ul style="list-style-type: none"> <li>• Estimates of adult height, weight and other body measurements</li> <li>• The time an adult would take to perform an everyday task.</li> </ul>	
s10	Be able to find and use relevant information from a variety of sources.	When familiarising themselves with the pre-release data learners should use a variety of information sources.	
s11	Be able to evaluate critically information in public statements such as news reports and political comments.	e.g. Conclusions drawn from data, statements involving percentages.	
s12	Be able to understand accounts of statistical work done by others and comment on its quality.		

# PROCESS AND PRESENTATION

## Raw data

	Content	Notes	Resources
s13	Be able to select suitable techniques for processing raw data.	Typically these data will have been obtained from a sample.	Integral Resources - OCR (MEI) Level 3 SPS: <a href="#">The Problem Solving Cycle - The long and short of it</a> <a href="#">Is this a valid argument?</a>
s14	Be able to clean data including dealing with missing data and outliers.	An outlier is an item which is inconsistent with the rest of the data.  The term is sometimes applied to data which are: <ul style="list-style-type: none"><li>• at least 2 standard deviations from the mean</li><li>• at least <math>1.5 \times</math> inter-quartile range beyond the nearer quartile.</li></ul>	External Resources: <a href="#">Are You Suited?</a>  <a href="#">The Standard Deviation Tutorial</a>  <a href="#">Cleaning Dirty Data</a>  <a href="#">Height Investigation S1</a>  <a href="#">Application Of Number</a>

# PROCESS AND PRESENTATION

## Graphs, charts and summary measures

	Content	Notes	Resources
s15	Be able to select suitable data displays and summary measures to show the main features of raw data.	<p>e.g. Standard statistical diagrams, Cartesian graphs.</p> <p>e.g. Mean, standard deviation, median, inter-quartile range.</p> <p>e.g. Index numbers derived from data. (Learners will be given sufficient guidance.)</p>	<p>Integral Resources - OCR (MEI) Level 3 SPS: <a href="#">Problem Solving Cycle - The long and the short of it</a> <a href="#">Is this a valid argument?</a></p> <p>External Resources: <a href="#">Graphing U.S. Presidential Elections</a> <a href="#">How Safe Is My Town?</a> <a href="#">To Invest or Not to Invest</a> <a href="#">The Standard Deviation Tutorial</a></p>
s16	Be able to use data displays to check whether distributions being used are realistic.	e.g. A histogram, frequency chart or Normal probability plot to check a distribution is approximately Normal.	

# PROCESS AND PRESENTATION

## Parameters and inputs; Calculations

	Content	Notes	Resources
s17	Use standard statistical notation for samples.		Integral Resources - OCR (MEI) Level 3 SPS: <a href="#">Measures of Location and Spread</a> <a href="#">Linear Transformation</a> <a href="#">Problem Solving Cycle - The long and the short of it</a> <a href="#">Is this a valid argument?</a>  External Resources: <a href="#">Spot the error</a> <a href="#">Descriptive Statistics</a> <a href="#">Music Festival</a> <a href="#">News story – Texts</a> <a href="#">Mr and Mrs Average</a>
s18	Be able to use sample data to estimate the parameters of a distribution or the inputs for a procedure or model.	Includes variance and standard deviation.	
s19	Be able to use the statistical functions of a calculator to find the mean and standard deviation.	Most calculators have two forms of standard deviation; either is acceptable.	
s20	Understand the use of a datum level as a base for measurement or calculation.		
s21	Know how the mean and standard deviation are affected by linear transformations.	Use in change of units and origin for measurement.	
s22	Be able to substitute input values into a model or procedure.		



# PROCESS AND PRESENTATION

## The Normal distribution

	Content	Notes	Resources
u1	Be able to use the Normal distribution as a model and recognise when it is likely to be appropriate to do so.		Integral Resources - OCR (MEI) Level 3 SPS: <a href="#">The Normal Distribution and Probability Plots - Too short to be a footballer?</a>
u2	Be able to standardise a value from a Normal distribution with a given mean and standard deviation.	Standardised scores.	MEI Free Resources – Integrating Mathematical Problem Solving: The mathematics of business and finance: <a href="#">Modelling the market (part 1)</a>  External Resources:  <a href="#">Fundamentals of Statistics 2: The Normal Distribution Tutorial</a>
u3	Use the Normal distribution to estimate population proportions in the context of a problem.	Using software, calculator functions or statistical tables.	<a href="#">Census at School: Is our height Normal?</a>

# PROCESS AND PRESENTATION

## The $\chi^2$ test

	Content	Notes	Resources
h3	Be able to apply the $\chi^2$ hypothesis test to data in a contingency table.	<p>Including calculating the contributions of individual cells to the test statistic.</p> <p>The null hypothesis is that the classifications used for the rows and columns are independent.</p> <p>Tables of critical values will be provided.</p>	<p>Integral Resources - OCR (MEI) Level 3 SPS: <a href="#">Chi-Squared Hypothesis Test - Don't Drink and Drive</a></p> <p>MEI Free Resources – Integrating Mathematical Problem Solving: The mathematics of biology: <a href="#">Statistical testing in medicine</a></p> <p>External Resources: <a href="#">Calculating Expected Frequencies in Two Way Tables resources</a></p>
h4	Be able to interpret the $\chi^2$ results of a test.	<p>This may involve considering the individual contributions to the test statistic.</p>	<p><a href="#">Chi-Squared Tests for Two-Way (Contingency) Tables resources</a></p> <p><a href="#">Chi-Squared Tests of Goodness of Fit resources</a></p> <p><a href="#">Contingency Analysis of Prison Inmates and Staff</a></p>

# PROCESS AND PRESENTATION

## Bivariate data; Spearman's rank correlation; Product moment correlation

	Content	Notes	Resources
b1	Know the vocabulary associated with bivariate data.	Association, correlation, line of best fit, dependent variable, independent variable.	Integral Resources - OCR (MEI) Level 3 SPS: <a href="#">Are we equal? - Correlation and Hypothesis Tests</a>
b2	Know how to calculate Spearman's rank correlation coefficient and carry out hypothesis tests using it.	The null hypothesis is that there is no association between the variables. Both 1-tail and 2-tail tests will be tested.  Tables of critical values will be provided.	MEI Free Resources – Integrating Mathematical Problem Solving: The mathematics of psychology: <a href="#">Correlational study</a> <a href="#">Take your partners</a>  External Resources: <a href="#">Pearsons Correlation Coefficient resources</a>
b3	Be able to use suitable technology to find Pearson's product moment correlation coefficient and to interpret the correlation coefficient.	Learners may be asked to calculate it using calculator functions for a small data set.	<a href="#">Spearman's Correlation Coefficient resources</a>

# REPORTING/INTERPRETATION

## Interpretation; Checking; Evaluation; Communication

	Content	Notes	Resources
s23	Be able to interpret the proposed solution in terms of the original problem.	Recognise the uncertainty of the outcome.	Integral Resources - OCR (MEI) Level 3 SPS: <a href="#">The Problem Solving Cycle - The long and short of it</a> <a href="#">Is this a valid argument?</a> <a href="#">Are we equal? - Correlation and Hypothesis Tests</a>  External Resources: <a href="#">How old is your height</a>  <a href="#">Height Investigation</a>  <a href="#">The best song ever</a>  <a href="#">Maui's Dolphin: Uncovering a new subspecies</a>
s24	Be able to interpret the result of a hypothesis test in terms of the original problem.		
s25	Recognise when the proposed solution is unreasonable.		
s26	Be able to identify and comment on possible sources of bias or error which may have affected the solution to a problem.	E.g. make reference to the sampling or experiment.	
s27	Recognise when the approach taken needs to be refined or replaced.		
s28	Be able to propose a refined or new approach.		
s29	Recognise that a “good enough” solution to a problem can save time and money compared to a more accurate solution.		
s30	Recognise when additional data collection would enable a better solution to a problem.		
s31	Be able to communicate the solution to someone who understands the problem.		

**Do you have any questions and want to talk to us?**

If you need specialist advice, guidance or support, get in touch by:

 **01223 553998**

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