

# Unit 18: Mathematics for IT

Unit code:	Y/601/5794
QCF Level 2:	BTEC Specialist
Credit value:	10
Guided learning hours:	60

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## Aim and purpose

To provide learners with an understanding of the mathematical techniques they will need to progress as an IT professional.

## Unit introduction

In order to work effectively as an IT professional, individuals need to have mathematical knowledge and be able to apply this knowledge. The purpose of this unit is to provide an introduction to a number of key mathematical ideas, to provide opportunities to develop useful skills and techniques and to be able to apply them in different areas of IT.

The unit starts by looking at how numbers are represented in computer memory. Learners will be expected to carry out a range of calculations using different number systems including binary, octal and hexadecimal and show how decimal numbers and integers are represented in different size computer registers.

Boolean algebra is introduced where the variables (0 and 1) are logical and the application includes mathematical and digital logic. The relation of Boolean algebra to digital electronics is explored.

Simple functions, such as straight lines and trig graphs, are defined and investigated by applying their use in software, to understand how functions can be represented visually using computers.

Finally the maths of statistics is explored with the collection and graphical representation of data used to apply statistical techniques.

## Learning outcomes and assessment criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria determine the standard required to achieve the unit.

### On completion of this unit a learner should:

Learning outcomes	Assessment criteria
1 Know how numbers are represented in computer memory	1.1 show how natural numbers are represented in computer memory 1.2 perform basic operations on numbers in power and scientific notation 1.3 demonstrate how errors are introduced when rounding decimal numbers
2 Be able to apply Boolean algebra	2.1 demonstrate Boolean operations using logic gates and truth tables 2.2 use Venn diagrams to represent Boolean operations
3 Be able to use simple functions	3.1 demonstrate the application of different types of function
4 Be able to apply statistical techniques	4.1 use statistical techniques to meet a defined need

## Unit content

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### 1 Know how numbers are represented in computer memory

*Numbers:* natural numbers (1,2,3...); integers (...-2, -1, 0, 1, 2, ...); real numbers (integers, fractions, decimals); binary numbers; number systems (base 10 (decimal), base 2 (binary), base 8 (octal), base 16 (hexadecimal)); rounding; degree of accuracy; errors; powers; scientific notation; floating point notation; fixed point notation

*Calculations:* basic operations (addition, division, multiplication, subtraction) on number systems, on powers, using scientific notation; rounding errors

*Computer memory:* representing integers and real numbers eg two's complement, Binary Coded Decimal; registers eg 8, 16, 32 bit

### 2 Be able to apply Boolean algebra

*Boolean operations:* AND; OR; NOT; conjunction; disjunction; negation or complement; logic gates; truth tables; Venn Diagrams for logic gates

*Digital electronics:* representing binary states as two voltage levels; use of logic gates in integrated circuits

### 3 Be able to use simple functions

*Definition:* dependent and independent variable; inputs (domain); outputs (range); notation  $y=f(x)$ ; types: linear; quadratic; trigonometric; examples eg  $y = mx+c$ ,  $y=ax^2 + bx + c$ ; simple trig functions and their inverses; linear functions and their inverses; applications eg if  $f$  denotes converting Fahrenheit to Centigrade then  $f^{-1}$  denotes converting Centigrade to Fahrenheit, distance as a quadratic function of time in Newton's Laws of Motion, alternating current as a sine curve

*Graphs:* using software to represent linear, quadratic and trig graphs eg spreadsheet, graphics package

### 4 Be able to apply statistical techniques

*Statistical techniques:* mean; median; mode; rank; quartile range, interquartile range; maximum; minimum

*Classification of data:* collection eg tally charts; tabulation; frequency tables

*Interpretation of graphical representations:* charts eg column, bar, line (scattergrams, linear equations, frequency curves), pie; analyse summary data; prove hypothesis; identify trends and patterns

## Essential guidance for tutors

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### Delivery

This unit could be delivered effectively within a workshop environment to allow learners time to progress through exercises, examine case study examples and use computing facilities. Learners will have varying levels of mathematical knowledge on entry and therefore teaching must cater for this differentiation. Although there is theoretical, the main emphasis of delivery must be on practical application and practice.

A comprehensive initial assessment will identify the level of each learner's skills and understanding and this could form the basis for a system that tracks each learner's skills and knowledge development. The content for the tracking system should include at least the content of this unit however it is important that any other mathematical programmes that learners are undertaking are also taken into account and connections made with other tutors as required. Regular formative assessment is necessary and this could be facilitated by the use of IT systems.

The unit content can be approached in the order that it is presented here, however an integrated approach that involves other units is strongly recommended. Learners will need to be given provided with a number of significant data sets and the context of these should be IT-related and examples could be summary data from reported problems to computer services or results from IT-related questionnaires.

## Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments. The outline learning plan demonstrates one way in planning the delivery and assessment of this unit.

Topic and suggested assignments/activities and/assessment
<b>Introduction to the unit</b>
<ul style="list-style-type: none"> <li>• whole-class exercise – tutor presentation on the use of mathematics in a range of different numeric systems, followed by individual exercise.</li> <li>• whole-class exercise – tutor presentation on how to perform calculations which use different numeric systems, followed by individual exercise.</li> </ul>
<b>Assignment 1 - Number Systems</b>
<ul style="list-style-type: none"> <li>• whole-class exercise – tutor presentation on how to perform calculations on a computer (including extended calculations), followed by individual exercise.</li> <li>• whole-class exercise – tutor presentation on calculation errors caused by switching between different numeric systems and by computer calculations, followed by individual exercise.</li> </ul>
<b>Assignment 2 - Calculations and Errors</b>
<p><b>Spreadsheet modelling:</b></p> <ul style="list-style-type: none"> <li>• whole-class exercise – tutor presentation on types of Boolean operations, followed by individual exercise</li> <li>• whole-class exercise – tutor presentation on Venn diagrams, followed by individual exercise</li> <li>• individual exercise – learners research the use of Boolean operations in digital electronics.</li> </ul>
<b>Assignment 3 - The Logical Choice</b>
<ul style="list-style-type: none"> <li>• whole-class exercise – tutor presentation on using mathematical functions, followed by individual exercise.</li> <li>• whole-class exercise – tutor presentation on how to use built-in spreadsheet features and functions, followed by individual exercise.</li> <li>• whole-class exercise – tutor presentation on presenting data graphically, followed by individual exercise.</li> <li>• whole-class exercise – tutor presentation on charts, what are they good for and how to represent data, followed by individual exercise.</li> </ul>
<b>Assignment 4 - The Correct Function</b>

Topic and suggested assignments/activities and/assessment
<p><b>Statistical techniques:</b></p> <ul style="list-style-type: none"> <li>• whole-class exercise – tutor presentation on different statistical techniques including mean, median, mode, rank, quartile range, interquartile range. Followed by individual exercise</li> <li>• whole-class exercise – tutor presentation on how can data be classified to aid understanding</li> <li>• whole-class exercise – tutor presentation on how to interpret data from charts, followed by individual exercise.</li> </ul>
<b>Assignment 5 - The Best Model</b>

### Assessment

It is suggested that this unit is assessed using two assignments as summarised in the *Programme of suggested assignments* table.

It may be appropriate to use prepared exercises to provide evidence for some of the criteria in this unit, but it is recommended that where possible these be set into a vocational context. Such exercises could be included in one or more assignments to be completed to a deadline, but centres are advised that timed tests or examinations would be outside the scope of the unit, which does not require calculations to be completed within a set time period.

Any exercises used must be assessed by the tutor against the relevant criteria in the grading grid, informed by the range of unit content and must not be marked in terms of numerical (for example/10) or percentage achievement. Where a particular set of calculations required to be completed by the unit content, then all calculations must be completed successfully and it is expected that workings will be shown where appropriate. Care must be taken that such activities are completed individually and that there is no scope for the sharing of answers between learners. Opportunities for collaborative work for particular criteria are indicated below, but where this occurs, evidence must be provided by each learner individually.

It is inevitable that much of this unit will be evidenced on paper or using a spreadsheet but, where possible, centres are encouraged to vary strategies to include verbal presentations, posters and other forms of visual evidence and to set activities within a vocational context.

Where descriptive or explanatory evidence is required, appropriate observation records completed by both learners and tutor may form part of the evidence.

For 1.1, learners must provide evidence that they can show how natural numbers are held in computer memory in the ways listed in the unit content for.

For 1.2, learners must provide evidence that they can describe the full range of calculations indicated in the unit content for different numeric systems including integers, decimals, fractions and binary numbers. Evidence may be provided from one or more exercises, or may occur naturally within the context of case studies or assignments; it would also be appropriate to provide evidence of the successful completion of calculations from appropriate activities in other units within this qualification. For final assessment, it is necessary for learners to show only that they know how to carry out each calculation.

For 1.3, learners need to demonstrate the different ways in which the use of computers introduces rounding errors when performing calculations on decimal numbers.

To achieve 2.1, learners must be able to demonstrate Boolean operations as listed in the unit content for learning outcome 2.

To achieve 2.2, learners must be able to demonstrate using Venn Diagrams to represent Boolean operations as listed in the unit content for learning outcome 2.

For 3.1, learners must provide evidence that they can use the full range of functions indicated in the unit content learning outcome 3. Evidence may be provided from one or more exercises, or may occur naturally within the context of case studies or assignments; it would also be appropriate to provide evidence of the successful use of functions from appropriate activities in other units within this qualification. For final assessment, it is only necessary for learners to show that they know how to use each function.

For 4.1, learners must show they can use statistical techniques to meet a specified need. This criterion will require learners to do work in a spreadsheet or other suitable software package and process data in the ways detailed in the unit content. It is recommended that tutors provide suitable data sets; it is not expected that learners provide the data sets themselves unless they wish to do so (if this choice is made then tutors should guide learners to appropriate data sets from which the range of graphical formats can be evidenced).

**Programme of suggested assignments**

The table below shows a programme of suggested assignments that cover the assessment criteria in the assessment and grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
1.1	Number Systems	A business has asked you to put together a brief guide to number systems, base 10 (decimal), base 2 (binary, base 8 (octal), base 16 (hexadecimal). The business would like you to support your brief guide by demonstrating how to convert to binary from each of the other systems.	Guide.
1.2, 1.3	Calculations and Errors	A business has asked you to put together a brief guide to using calculations. The business would like you to support your brief guide by demonstrating how calculations can solve problems and how errors can occur.	Guide.



### Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC in IT sector suite. This unit has particular links with:

Level 1	Level 2	Level 3
	Data Representation and Manipulation	Mathematics for IT Practitioners
		Advanced Data Representation and Manipulation

This unit maps to some of the underpinning knowledge from the following areas of competence in the Level 2 National Occupational Standards for IT (ProCom):

#### 4.2 Data Analysis

#### Essential resources

Learners will need access to a computer with a spreadsheet package. Graphing facilities, capable of satisfying the outcomes described, will need to be available if not provided by the spreadsheet. A good range of case study examples and exercises is needed.

#### Indicative reading for learners

##### Textbooks

Cameron P – *Introduction to Algebra* (OUP Oxford, 2007) ISBN 0198527934

Lawler G – *Algebra: Basic Algebra Explained* (Studymates LTD, 2005) ISBN 1842850687

Lawler G – *Understanding Maths: Basic Mathematics Explained* (Aber Publishing, 2007) ISBN 1842850865

Rowntree D – *Statistics without Tears: An introduction for Non-Mathematicians* (Penguin, 2000) ISBN 0140136320

##### Websites

[www.capitan.k12.nm.us/teachers/shearerk/basic\\_rules\\_of\\_algebra.htm](http://www.capitan.k12.nm.us/teachers/shearerk/basic_rules_of_algebra.htm)

[www.mindpicnic.com/course/statistics-for-dummies](http://www.mindpicnic.com/course/statistics-for-dummies)

[www.themathpage.com](http://www.themathpage.com)

## Functional Skills – Level 2

Skill	When learners are ...
<b>ICT - Developing, presenting and communicating information</b>	
Use communications software to meet requirements of a complex task	making a spreadsheet that can model calculations based on numerical data
Combine and present information in ways that are fit for purpose and audience	creating graphics for presenting data
<b>Mathematics - Representing</b>	
Identify the situation or problems and identify the mathematical methods needed to solve them	demonstrating how errors are introduced when rounding decimal numbers
<b>Mathematics - Analysing</b>	
Apply a range of mathematics to find solutions	demonstrating Boolean operations using logic gates and truth tables using Venn Diagrams to represent Boolean operations
Use appropriate checking procedures and evaluate their effectiveness at each stage	using statistical techniques to meet a defined need.