Introduction to Efofex Equations

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User's Guide

by Efofex Software

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1   The Basic Idea

Efofex's Equation Technology (including FX AutoQuate which automatically determines which bits of your entered text need to be interpreted as equations) is built into all of our products. This lesson set will usually refer to FX Equation but the lessons can be applied to all of our products. So with that it mind - onward!

FX Equation is DIFFERENT. It does NOT try to replace products which can produce every conceivable equation, such as MathType or Equation Editor. It focuses on something that is often more important to teachers...

SPEED

The idea for FX Equation was developed when our founder (while he was still teaching) was asked to develop an algebra course for fourteen year olds. After battling with a normal equation editor to produce seemingly thousands of algebraic expressions he decided that there HAD to be a better way to write the sort of equations a mathematics or science teacher requires.

With FX Equation, You Can Just Type

Much of the time you just type what you see. Sometimes you have to add extra formatting to your equation to ensure that what you type is not ambiguous. There are some codes or shortcuts to learn but these are minimal and logical.

For instance:

Enter

$$\textbf{x3+2x2+7}$$

and get

$$x^3 + 2x^2 + 7$$

With no extra input on your part. You can create basic equations as fast as you can type.

FX Equation can be used solely with the keyboard. No mouse clicks are required to produce equations but there is a backup, toolbar based system that you can use for those times you memory fails you.

The first job you need to do is to print the Quick Reference Card. The quick reference card summarizes all the important features of FX Equation and how to use them.

1.   Load FX Equation

2.   Go to the Help menu

3.   Choose Quick Reference Card (requires that Adobe Acrobat Reader be installed)
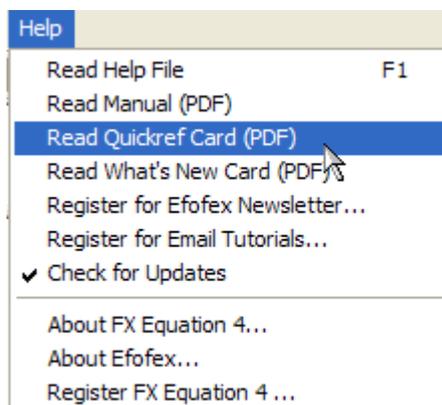
4.   Print it and place it near your computer.

After a while things will become second nature but this is your best source of information to begin with.

2   Using FX Equation from Inside Word (Windows Only)

Even though FX Equation adds itself to your Start menu, the best way to use it is from within Word.

To use FX Equation in this manner...

1. Load Word
2. When you wish to insert a diagram, push the LEFT HAND FX Equation 4 button that has been added to your toolbars. If you have not got an FX Equation 4 button, see the note below.
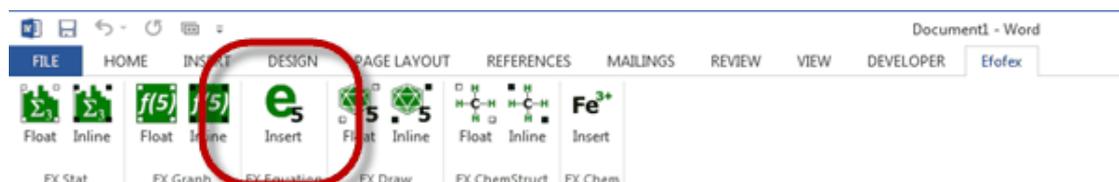
3. Enter your equation - try typing sin2 x = pi/2 this time. You should see your equation being formatted inside the FX Equation Window.

4. Once you are happy with your equation, click on the GREEN TICK.
5. You should now be returned to Word and your equation should be on your page. If you wish to edit your equation later on, DOUBLE-CLICK on it. FX Equation will reopen and let you edit the equation. To return to Word, click on the GREEN TICK again and your changes will be shown in your Word file.

3   Powers

Most powers will be automatically recognised by FX Equation and raised to the appropriate level.

For example – type:

4x3+2x2-3x

$$4x^3 + 2x^2 - 3x$$

(x2-2)2

$$\left(x^2 - 2\right)^2$$

sin2 x

$$\sin^2 x$$

In all of these situations, FX Equation will automatically find the powers. FX Equation **automatically** treats any number immediately following a letter or any number immediately following a bracket as a power.

This normally raises three questions…

1.   What if I really want x2 without the two being raised to a power?

The simple answer is "too bad". In reality this is not a common thing and it seems illogical to force you to type in a symbol every time to accommodate this rare occurrence. The complex answer is that you can actually achieve this using FX Equation by typing

x"2"   or   x 2 (with a space between)

We will explain why that works in a later lesson.

2.   What do I do when FX Equation does NOT automatically raise to a power?

There are a few situations where FX Equation does NOT raise to a power automatically – for example two to the power x. Obviously converting 2x to two to the power x is NOT the best thing to do!

When you want to force FX Equation to raise to a power, use the ^ sign (usually shift 6). This is a commonly used symbol for exponentiation.

2^x

3.   Hang on… how do I get sin 2x WITHOUT the 2 being raised as a power?

We will cover this in more detail later but the simple answer is to put a space between the n and the 2

sin 2x   rather than sin2 x

The space stops FX Equation from raising the 2.

4   Fractions

Writing fractions with FX Equations is extremely easy and quick. Fractions are written using the / key.

For example:

1/4

$$\frac{1}{4}$$

x/y

$$\frac{x}{y}$$

x3/3

$$\frac{x^3}{3}$$

There is only one trick to writing fractions but it is a logical one. When writing fractions on a piece of paper, the fraction line operates **like a set of brackets** – tying together all terms in the numerator for example. When entering fractions into FX Equation, you have to explicitly type those brackets to indicate to FX Equation which things are included in the fraction.

For example, type:

(x2+x)/x

$$\frac{x^2 + x}{x}$$

$$\texttt{x2+x/x}$$

$$x^2 + \frac{x}{x}$$

See the effect the brackets have?

Now for the common question.

OK. I understand fractions but how do I get a division sign?

Easy. Type a space after the / and FX Equation will replace the fraction with a division sign.

Try

$$1/\ 2$$

$$1 \div 2$$

5   Spaces

Spaces are obviously important to FX Equation – but how do they work? FX Equation interprets equations as you type them and uses rules such as "If a number directly follows a letter or a bracket then raise it to a power". By placing a space in an equation, you prevent the rule from operating.

If FX Equation is doing something automatically that you do not want to occur, just add a space.

6   Greek Letters

Greek letters are entered by typing the first two characters of the letter's name - for example α (alpha) is entered as **al** and β (beta) as **be**.

Uppercase Greek letters are entered as the first two characters of the letter's name, entered in uppercase. For example, Π (uppercase pi) is entered as PI.

FX Equation gives you access to all the Greek letters using this approach.

FX Equation supports the following codes:

al,be,ch,de,DE,ph,PH,ga,GA,la,LA,mu,pi,th,TH,rh,si,SI,pi,PI,om,OM,ep,ze,et,io,ka,nu ,xi,XI,ta,up,UP,ps,PS

Upper case Greek letters (such as upper case alpha) which are represented by a character available in the standard alphabet do not have codes allocated.

7   Symbols

Mathematics and science teachers require access to a large number of mathematical symbols and FX Equation provides access to these symbols through a variety of codes. The codes are discussed in the manual and are listed on the quick reference cards.

There are two main categories of codes and this can help you remember the codes you need.

Codes based on common conventions:

```
        < >                          ≠
         *                         *, × or ·
  / (followed by a space)            ÷
```

Codes that are "constructed" from various pieces of the final symbol or that rely on physical similarities between the code and the symbol

```
        <=                           ≤
        >=                           ≥
        =/                           ≠
   =~  or  ~=                        ≅
        ~~                           ≈
        -=                           ≡
        +-                           ±
   `  or  o                          ∘
        ->                           →
        =>                           ⇒
```

You will notice that there are some symbols which have more than one code – not equal to for example.

Codes that are based on words

```
        inf                          ∞
        tri                          Δ
        ang                          ∠
        perp                         ⊥
        and                          ∩
        or                           ∪
     element                         ∈
    notelement                       ∉
      subset                         ⊂
     notsubset                       ⊄
```

propersubset	⊆
prop	∝
pd or @	∂
tf	∴
te	∃
fa	∀
au	Å
nabla	∇

You do not need to remember all of these codes. All of these symbols can also be accessed using our Toolbar Equation Entry system

DEGREES SYMBOL

One of the most often asked questions is "How Do I Get a Degrees Symbol?".

The answer is the back-dash key or lowercase 'o'.

On most keyboards you will find a backwards facing dash `. It is NOT the single quote key next to the semicolon on most keyboards.

This key is used by all Efofex products to enter degrees symbols.

8   Brackets

There are two important points to remember about brackets in FX Equation.

1.   All bracket types are treated the same.

FX Equation treats ({ and [as equivalent entities. Similarly, it considers) } and] to be **logically** identical. This means that it will format

```
(x+2)/2
```

```
{x+2}/2
```

```
[x+2)/2
```

identically.

2.   FX Equation considers some brackets to be "logical".

FX Equation uses them to determine HOW to display something **but does not actually display the brackets**.

For example:

```
(x+2)/2
```

$$\frac{x+2}{2}$$

The brackets are needed to logically define the fraction but are **not displayed by FX Equation**.

FX Equation also treats brackets around powers and subscripts as "logical" brackets and does not display them.

For example:

```
x^(x+1)
```

$$x^{x+1}$$

```
T\(n+1}
```

$$T_{n+1}$$

9   Toolbar Equation Entry

FX Equation can be operated without ever touching the mouse and the keyboard commands FX Equation uses are highly efficient for most equations. Sometimes, however, you will want to construct something obscure or using commands that you rarely use. FX Equation offers a toolbar equation entry system that makes this easy.

Most of these buttons (apart from first one and last two) hides a set of related commands.
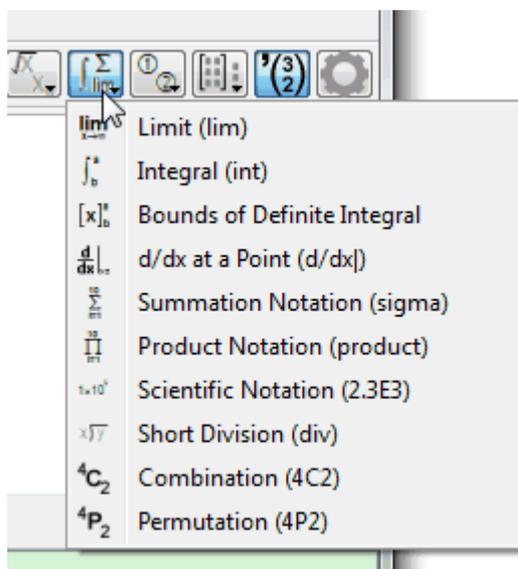
You do not **have** to use the toolbar equation entry system and most times it will be quicker to just type in the simple command. The toolbar equation entry system just means that you never have to remember!

10   Limits, Summation, Products & Integrals

FX Equation can be used to write limits, summation notation, product notation and integrals. All four features use the same format – the command followed by the parameter(s) in brackets

eg

lim(x->8)

$$\lim_{x \to 8}$$

sigma(i=1,10)

$$\sum_{i\,=\,1}^{10}$$

product(i=1,10)

$$\prod_{i\,=\,1}^{10}$$

int(-2,3)

$$\int_{-2}^{3}$$

Notes:

lim

The parameter for limits usually includes the arrow symbol , accessed by typing ->.

sigma / product

The first parameter goes below the sigma/pi symbol, the second parameter goes above.

int

The lower bound is entered first. Bounds can include pi or any other equation components.

11   Special Formatting Characters

We have already seen how the ^ key is used to indicate powers in FX Equation. FX Equation has other special formatting characters that are useful.

1.   Subscripts

The backslash key (\ ) is used to indicate subscripts. Think of it as **"sliding downhill"**. Any character immediately following \ will be subscripted.

T\n

$$T_n$$

If you want to subscript an expression, you need to wrap the expression in brackets.

`T\(n+1)`

$$T_{n+1}$$

The brackets are "logical" brackets and will not be displayed by FX Equation.

Please Note: On some keyboards (for example the Swedish keyboard) the \ key is missing. In those cases it can be replaced by the § key.

2.   Means & Complements

You can add a straight line ABOVE a character by typing an underline (_) immediately AFTER the character.

`x_`

$$\overline{x}$$

Typing an underline after brackets will add a straight line above all elements in the brackets. The brackets will be treated as logical brackets and not shown.

`(x+2y)_`

$$\overline{x + 2y}$$

3.   Predictions

If you wish to type a "hat" over a character (used for predictions in statistics) you type ^^ after the character. You need to use the double hat otherwise FX Equation will interpret the ^ as a power.

`y^^`

$$\hat{y}$$

4.   Dots

You can add dots above characters by typing a colon (:) immediately AFTER the character.

`x:`

$$\dot{x}$$

You can add a double dot above a character by typing two colons.

```
x::
```

$$\ddot{x}$$

12   Other Useful Commands

1.   box

The box command can add empty "fill in the box" boxes or you can draw a box around any component of your equation.

```
3+box = 8
```

$$3 + \boxed{} = 8$$

```
x=(-b+-box(sr(b2-4ac)))/2a
```

$$x = \frac{-b \pm \boxed{\sqrt{b^2 - 4ac}}}{2a}$$

2.   Combinations and Permutations

```
12C3
```

$$^{12}\mathbf{C}_3$$

```
(n+1)Pn
```

$$^{n+1}\mathbf{P}_n$$

13   FX AutoQuate

FX AutoQuate is an Efofex technology that allows you to combine normal text and equations as you type.

You Type - FX AutoQuate Sorts It Out

This allows you to type something like

The equation is y=(x2-4)/(x-3)

and automatically get

$$\text{The equation is } y = \frac{x^2 - 4}{x - 2}$$

To turn FX AutoQuate on, just put a check mark in the Auto box.

What if FX AutoQuate Gets It Wrong?

Turn it off and manually select the sections of your text that you want as equations by marking with the 1/x button.

14   Recurring Decimals & Scientific Notation

You can easily input recurring decimals using FX Equation's special formatting characters.

`3.1:`

$3.\dot{1}$

`3.234_`

$3.23\overline{4}$

`6.874_1234`

$6.874\overline{1234}$

Scientific notation can be quickly entered using the "E" notation commonly used in computers and calculators.

`3.2E12`

3.2×10^{12}

`-4.7E-2`

-4.7×10^{-2}

15   Roots

Roots are entered using one of three codes

`sr`	-	square root (short code)
`sqrt`	-	square root (long code)
`root`	-	general root (eg fourth root)

Square Roots

If you place these codes immediately in front of a term, that term will be under the root sign.

sr3

$$\sqrt{3}$$

sqrt9x2

$$\sqrt{9x^2}$$

If you wish to construct a more complex root, such as the discriminant of the quadratic formula, you need to surround the expression with brackets.

sr(b2-4ac)

$$\sqrt{b^2 - 4ac}$$

The root sign will expand to contain whatever is within the brackets.

sr(x2/(2+x/3))

$$\sqrt{\dfrac{x^2}{2 + \dfrac{x}{3}}}$$

nth Roots

root(x2)

$$\sqrt{x^2}$$

3root(x2)

$$\sqrt[3]{x^2}$$

(n+1)root(x2+sr3)

$$\sqrt[n+1]{x^2 + \sqrt{3}}$$

16   Vectors

1.   Column Vectors

FX Equation can automatically detect and format column vectors.

$$(2,3) \quad \text{or} \quad (2\&3)$$

$$\begin{pmatrix} 2 \\ 3 \end{pmatrix}$$

$$(3,4,5,6,7,8) \quad \text{or} \quad (3\&4\&5\&6\&7\&8)$$

$$\begin{pmatrix} 3 \\ 4 \\ 5 \\ 6 \\ 7 \\ 8 \end{pmatrix}$$

The brackets are actually superfluous; it is the commas that indicate to FX Equation that you wish to format the numbers vertically.

Ampersands will ALWAYS be interpreted as column vectors.

Commas will only be interpreted as column vectors if this button is selected.

This allows you to use FX Equation to write ordered pairs

(2,3)

Please Note: In countries that use , as a decimal point, you enter vertical vectors using Window's separator - most commonly ;

2.   Double Capital Vectors

If you type two capital letters

AB

FX Equation can automatically

a)   Ignore them
b)   Draw a horizontal bar over them to indicate a line segment
c)   Draw a right pointing arrow over them to indicate a ray or vector
d)   Draw a double arrow over them to indicate a line.

Try it.

You can change this behaviour by going to the Preferences screen, choosing Vectors and selecting your preferred option.
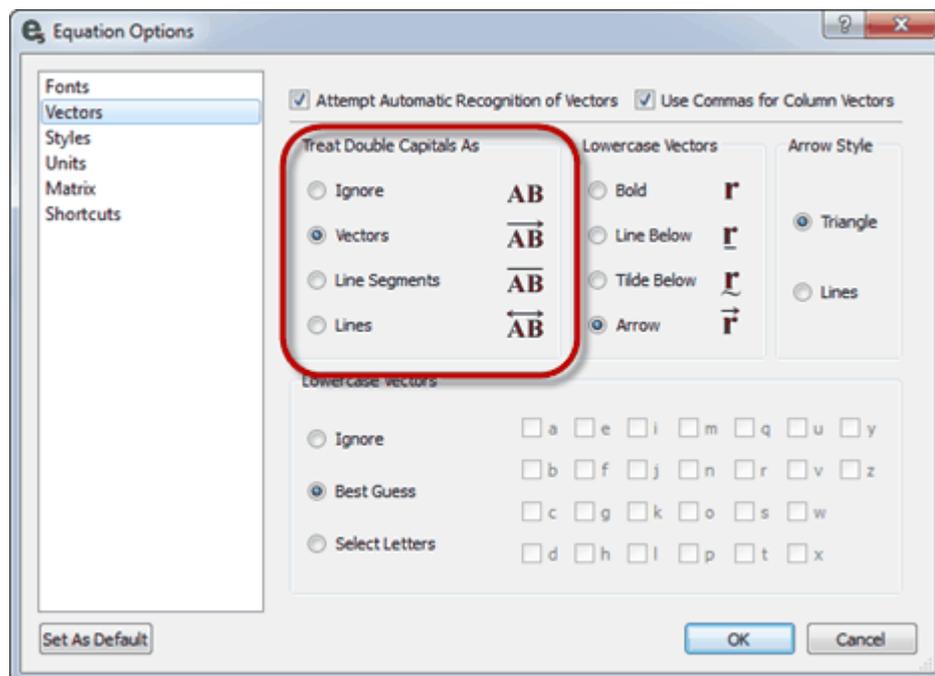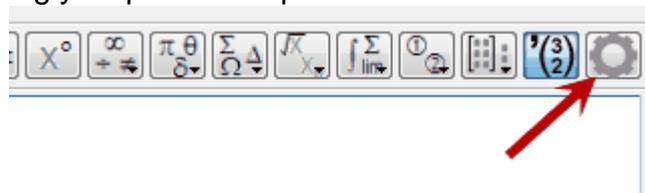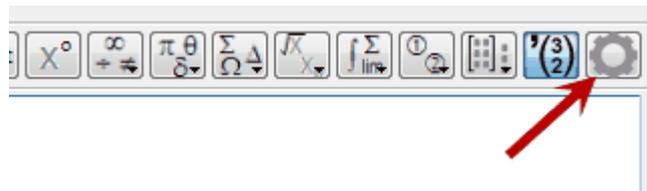

3.   Lower Case Vectors

FX Equation can automatically recognise most expressions containing lower case vectors.

```
r = 3i+2j
```

$$\underline{r} \ = \ 3\underline{i} \ + \ 2\underline{j}$$

FX Equation will automatically detect that what you have typed is a vector and will mark the r, i and j as vectors using your currently selected display option.
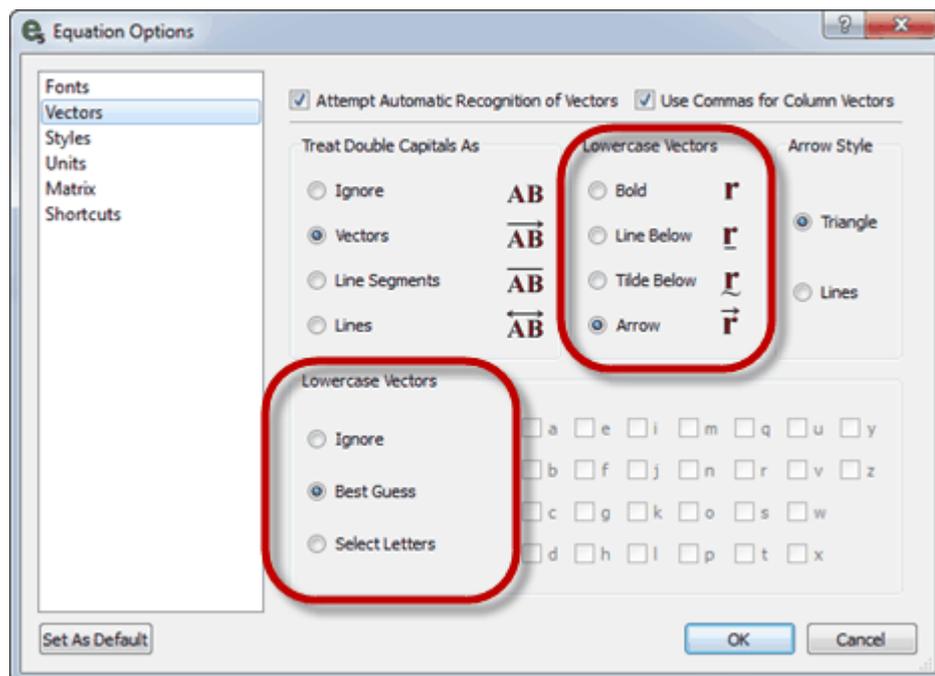
There are three ways of using this feature and you can set your preferences by going to the Preferences screen and choosing Vectors.

You can

a)   Turn it off
b)   Let FX Equation make its best guess
c)   Explicitly tell FX Equation which lower case letters to treat as vectors.

Usually it is best to just let FX Equation make its best guess.

17   Arrows

FX Equation can add left, right and double arrows over any equation components.

```
-->(mn)
```

$$\overrightarrow{mn}$$

```
<--(3x)
```

$$\overleftarrow{3x}$$

<->(ABC)

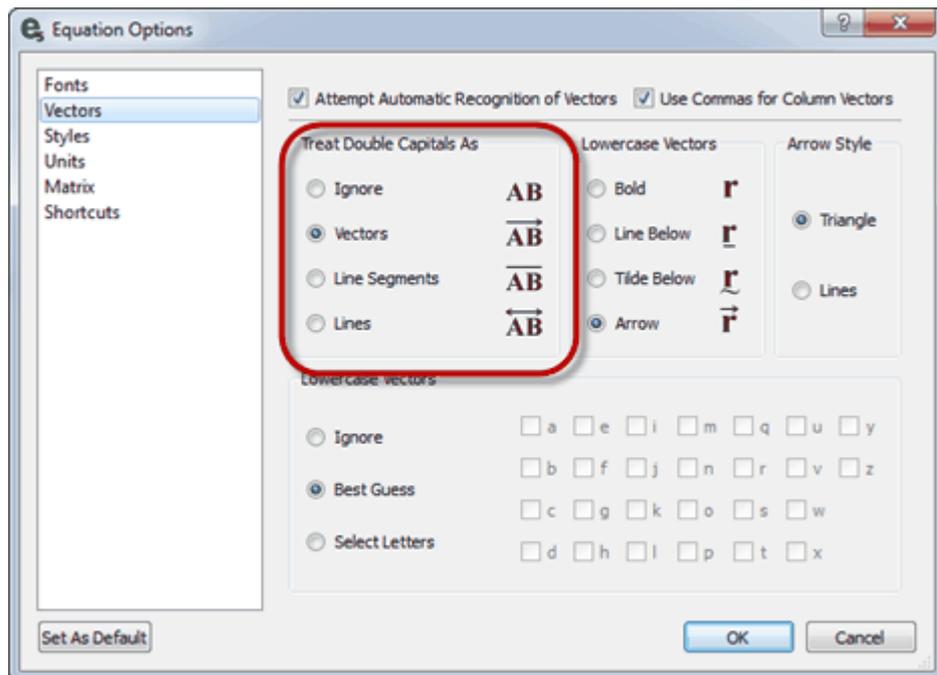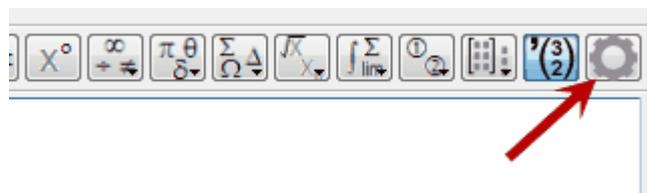$$\overleftrightarrow{ABC}$$

If you plan to use this notation with double upper case letters, you should turn off automatic double upper case handling to prevent FX Equation from formatting them twice.

<->(AB)

$$\overleftrightarrow{AB}$$

Set this option to ignore.

<->(AB)

$$\overleftrightarrow{AB}$$

18   Matrices

FX Equation has a small limitation with its support for matrices – it can format any number of columns but only up to twenty rows.

In the last lesson we said that the brackets around a column vector were superfluous. We can use this to format matrices.

`[ 2,3  4,5]`

$$\begin{bmatrix} 2 & 4 \\ 3 & 5 \end{bmatrix}$$

The space(s) between the three and four indicate to FX Equation that you have finished one column and wish to start the next.

This process can be extended to twenty rows

`[1,2,3  4,5,6  7,8,9  10,11,12  13,14,15]`

$$\begin{bmatrix} 1 & 4 & 7 & 10 & 13 \\ 2 & 5 & 8 & 11 & 14 \\ 3 & 6 & 9 & 12 & 15 \end{bmatrix}$$

You have a number of settings you can change for matrices. These settings can be accessed through the Preferences screen.
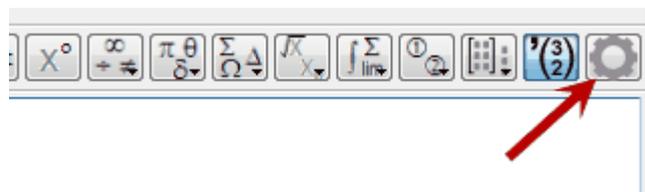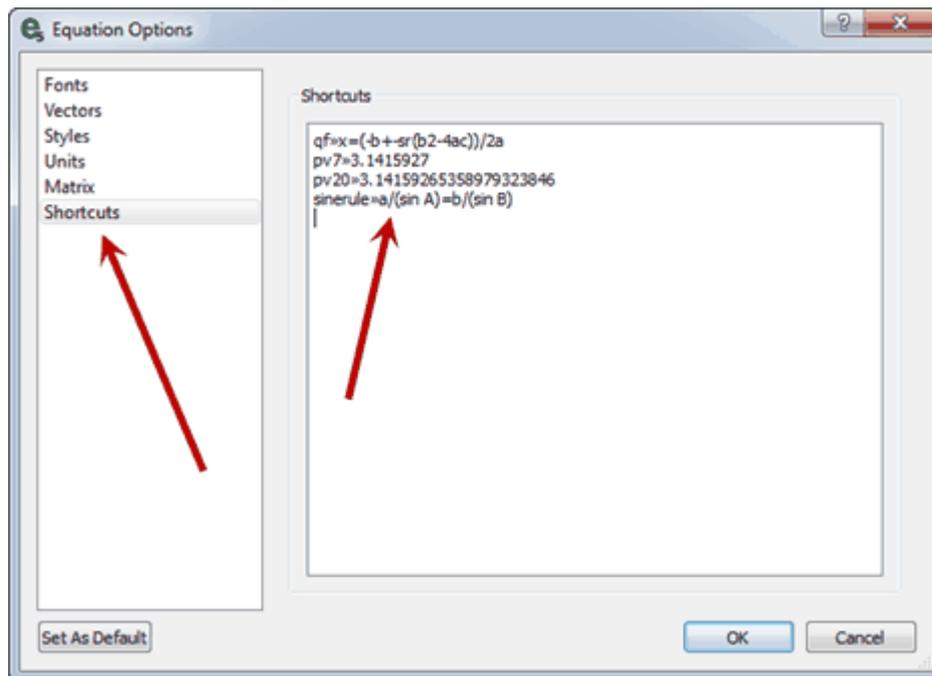
19   Shortcuts

You can program shortcut codes into FX Equation that allow you to enter complex equations with just a few keystrokes.

For example, FX Equation is shipped with a built in shortcut that automatically produces the quadratic formula when you type `qf`
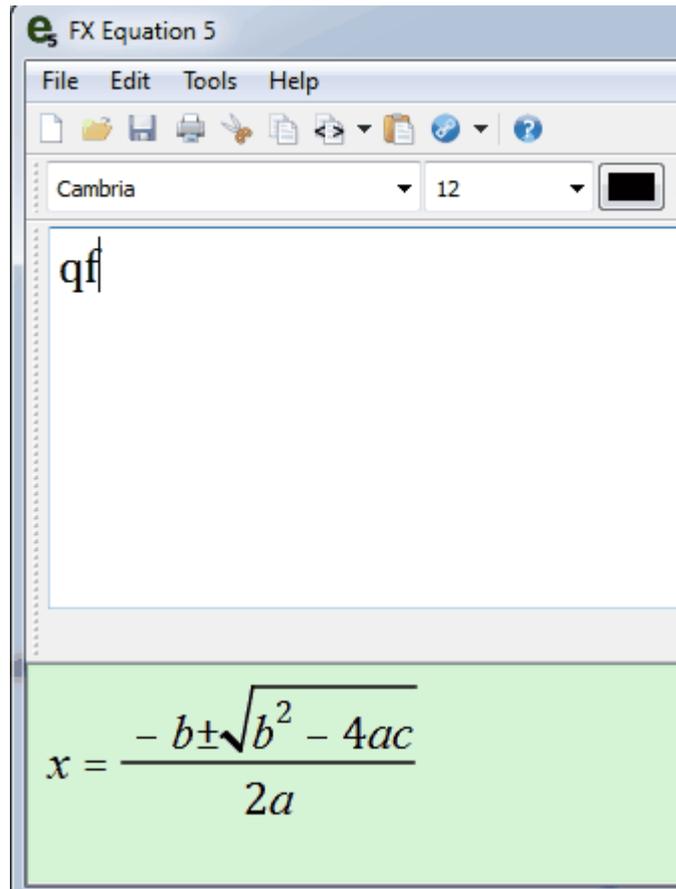
You can create your own shortcuts by opening the Preferences screen.

You type your desired code, the tab key, and then the expansion. You can see the qf shortcut at the top of the list. Press the Set As Default button if you wish to save your shortcuts for later.