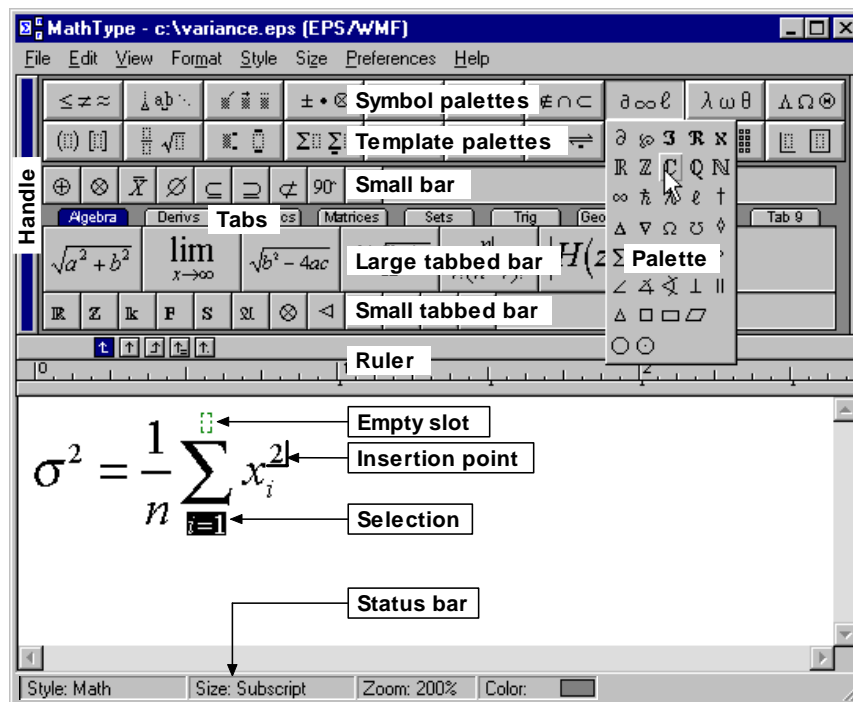## The MathType Window

The picture below shows MathType with all parts of its toolbar visible:

Within the equation area itself, there are four items of interest:

Empty Slot

A slot containing no text is displayed with a dotted outline.

Insertion Point

A blinking marker consisting of a horizontal line and a vertical line that indicates where text or templates will be inserted next.

Selection

The part of the equation that will be affected by any subsequent editing commands is highlighted.

Status Bar

The Status Bar contains four areas that tell you your current settings for Style, Size, Zoom, and Color. You can change these settings using menu commands or simply right-click on an area to show a menu for that setting. While moving the mouse in the toolbar or in the menus, the four Status Bar entries are temporarily replaced by a message that describes the item the mouse pointer is over. At other

to delete the selection. Pressing the ENTER key will start a new line below the original line. Immediately after typing, you can choose the Undo Typing command on the Edit menu to erase everything that you typed since the last non-typing operation.

Why the Spacebar Doesn't Work

The SPACE key usually has no effect, since MathType performs spacing of mathematical equations automatically. Professional-quality mathematical formatting involves six different space widths, none of which is the same width as the space character in most fonts, so it would be undesirable to insert the standard space character into your equations. Many people find this a bit confusing at first, but you will get used to it quickly. However, sometimes you might want to insert a non-mathematical phrase into your equations and, here, the standard space is exactly what you want. To do this, just change the current style to Text and start typing. See Tutorial 4 in Chapter 4 for details.

Sometimes you may find it necessary to override MathType's automatic spacing. There are CTRL (Control) key shortcuts for entering various widths of space; for instance, CTRL+SPACE inserts a thin space. See Tutorial 6 in Chapter 4 for more information.

Inserting Symbols

Keyboard Shortcuts
MathType also provides keyboard shortcuts for inserting almost all symbols on the palettes. These are shown in the Status Bar when the mouse is over each symbol. You can also assign your own keyboard shortcut to any symbol. See Tutorial 16 in Chapter 4 for more information.

To insert a symbol, you click on it in one of the bars, or choose it from one of the Symbol Palettes, as shown in the picture below. The Symbol Palettes work like standard Windows menus — just press or click the left mouse button to display the palette's contents, then choose the desired symbol. The symbol will be inserted immediately to the right of the insertion point or, if something is selected, the symbol will replace it.

Chapter 4
Tutorials

Before You Start

This chapter contains several tutorial examples of using MathType. We provide step-by-step instructions for each example, so you should find it easy to work through them. Each tutorial should take you no more than 10 minutes, and they are by far the best way to learn MathType. Before you start, however, there are a few things to bear in mind.

First, recall that you can find symbols and templates either in the palettes at the very top of the MathType window, or in the bars lower down. You have to pull down the palettes to find the items you need, but you can just click on the ones in the bars. For the most part, the tutorials will require very common symbols and templates that we placed in the bars for you before we shipped MathType. You can change the contents of these bars at any time; we explain how in Tutorial 5.

Undo and Redo
You can also correct mistakes by using the Undo command on MathType's Edit menu. In MathType 5 you can Undo and Redo an unlimited number of times.

Also, you do not have to worry about making mistakes. If you type something wrong, or choose the wrong symbol from one of the palettes, you can correct your mistake by pressing the BACKSPACE key.

Fonts and the Appearance of Your Equations

The tutorials will often tell you that "your equation should now look like this." In fact, the appearance of your equation will be determined by the fonts you are using, so you shouldn't take this statement too literally. MathType's default fonts are Times New Roman, Symbol and MT Extra. These fonts will probably be acceptable, at least for the purposes of working through the tutorial, and we recommend that you stick with them until you've gained some experience working with MathType.

For the time being, please do ***not*** change fonts by using the Other command on the Style menu — as you'll see in Tutorial 8, there's a much better way of doing this in MathType, and we don't want you to get into any bad habits.

Some Final Advice

In the first few tutorial examples, we're going to assume that you're using MathType along with Microsoft Word to create a document. MathType works with a wide variety of word processing, publishing, Web editing and graphics programs, but Word is by far its most common companion. If you want to work through the tutorials using some other word processing application, it should be easy to adapt the instructions that follow. Also, detailed instructions for using MathType with other applications are available in Chapter 5.

In the tutorials, we'll often tell you to type certain characters into your equations. The characters you have to type will be shown in **bold** type.

Tutorial 1: Fractions and Square Roots

In our first tutorial, we will create the equation

$$y = \sqrt{\tfrac{3}{16}} \sin x - c^2 \pm \mu \tan x$$

This is a very simple equation, but you'll learn about fractions and square root templates, and we'll explore the properties of the insertion point, and illustrate MathType's function recognition and automatic spacing capabilities.

To create the equation, just follow the steps listed below. Remember that the characters you have to type into the equation are shown in **bold type**.

1. Open a new Word document, and type a few lines of text, just to make the situation a bit more realistic.

2. Now we're ready to insert a MathType equation. If you installed MathType correctly, there should be a MathType menu towards the right-hand end of the Word menu bar, as shown below.

Word Toolbar
You can insert a display equation using the $\boxed{\Sigma}$ button on Word's MathType toolbar. You can see what each toolbar button does by holding the mouse pointer over the button for a couple of seconds. A tooltip will appear containing the name of the button's command.
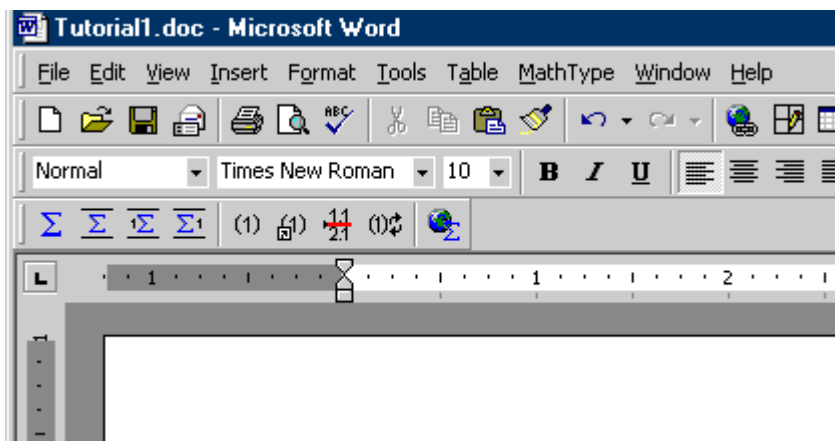
From the MathType menu choose the Insert Display Equation command. This will open a MathType window, ready for you to start creating the equation. If for some reason neither the MathType menu nor the MathType toolbar is available in Word, use Word's Insert Object command (choose Object on the Insert menu), and choose MathType 5.0 Equation from the list of object types displayed. See Chapter 5 to learn about other ways to insert an equation, either in Word or other applications.

3. In the MathType window, type **y=**. You don't have to type a space between the y and the =, because MathType takes care of the spacing automatically. To help you break the habit of typing spaces, the spacebar is disabled most of the

time in MathType, so pressing it will have no effect (other than producing an annoying beep!). Chapter 7 discusses where and how you should enter spaces in MathType, but you won't have to do this very often.

Also, notice that the *y* has been made italic, but the = sign has not. Mathematical variables are almost always printed in italics, so this is the default in MathType. You can change this by redefining the Variable style using the Define command on MathType's Style menu. See Chapter 7 for details.

4.   Now we need to enter a square root sign. To do this, click on the $\sqrt{\square}$ icon in the Small Bar. The $\sqrt{\square}$ template's home is in the $\boxed{\frac{\square}{\square}\; \sqrt{\square}}$ palette, but we've also moved it into the Small Bar to make it easier for you to find. Your equation should now look like this:

$$y = \sqrt{\square}$$

The characters in the equation might be larger than you expect, but this is just a result of the viewing scale you're using. You can use the commands on the View menu to change the viewing scale to anything between 25% and 800%. The blinking insertion point should be in the slot under the square root sign, indicating that whatever you enter next will appear there.

Fraction Template
As you hold the mouse pointer over the palette items their name is displayed in the status bar at the bottom of the MathType window. This will help you make sure you pick the correct template.

5.   Next, we enter a fraction template. To do this, go to the $\boxed{\frac{\square}{\square}\; \sqrt{\square}}$ palette and choose the $\frac{\blacksquare}{\blacksquare}$ template — it's the one on the right in the top row. This template produces reduced-size fractions, sometimes known as "case" fractions in the typesetting world. Case fractions are generally used to save space when the numerator and denominator of the fraction are just plain numbers. Be careful not to choose the larger $\frac{\square}{\square}$ template — this would create a full-size fraction, which would be too big for this situation. Notice how MathType automatically expands the size of the square root sign to accommodate the fraction. Your equation should now look like this:

$$y = \sqrt{\frac{\square}{\square}}$$

The insertion point should be in the numerator (upper) slot of the fraction template.

6.   To enter the numerator of the fraction, just type **3**.

7.   Now we need to move the insertion point down into the denominator slot of the fraction. You can do this by pressing the T<small>AB</small> key or by clicking inside the denominator slot in your equation.

8.   Enter the denominator by typing **16**.

9.   Next we need to add the $\sin x$ outside of the square root sign, and to do this we have to get the insertion point into the correct position in the hierarchy of slots that make up the equation. If you repeatedly press the T<small>AB</small> key, you can

make the insertion point cycle through all the slots in the formula. If you hold down the SHIFT key while you do this, the insertion point will cycle through the slots in the reverse direction. Try this out to see how it works. Three of the positions that the insertion point will assume during the course of this cycling are shown below. Use a viewing scale of 400% or 800%, so that you can see what's happening a little better:

$$y = \sqrt{\frac{3}{16}} \qquad y = \sqrt{\frac{3}{16}} \qquad y = \sqrt{\frac{3}{16}}$$

If you use the Show Nesting command on the View menu, you can get an even better picture of the hierarchical arrangement of slots in your equation:

$$y = \sqrt{\frac{3}{16}} \qquad y = \sqrt{\frac{3}{16}} \qquad y = \sqrt{\frac{3}{16}}$$

We have to decide which of these insertion point positions is the right one for adding the $\sin x$. The position on the left is clearly wrong — we don't want the $\sin x$ to go in the denominator of the fraction. In the position shown in the center, the insertion point is in the main slot under the square root sign, so if we type in $\sin x$ the result will be the following formula:

$$y = \sqrt{\frac{3}{16} \sin x}$$

This is not what we want either. The insertion point position shown on the far right is the correct one; the insertion point is outside the square root, which is where we want the $\sin x$ to go.

Functions
You can customize the list of functions that MathType automatically recognizes. Tutorial 4 contains an example.

10. Keep pressing the Tab key until the insertion point arrives in the correct position, and then type in the letters **sinx**. Type slowly, so that you can watch what happens. When you initially type them, the s and the i will be italic, because MathType assumes that they are variables. However, as soon as you type the n, MathType recognizes that sin is an abbreviation for the sine function. Following standard typesetting rules, MathType uses plain Roman (non-italic) format for the sin, and inserts a thin space (one sixth of an em) between the sin and the x.

11. Type **–c**. Remember you don't have to type the spaces. You insert the minus sign by pressing the – (minus/hyphen) key on your keyboard. In a word processor, pressing this key inserts a hyphen, which is typically shorter than a minus sign. However, since hyphens are very uncommon in mathematics, MathType replaces them by minus signs for you (when the Math style is in effect). Your equation should now look like this:

$$y = \sqrt{\tfrac{3}{16}} \sin x - c$$

12. Next we need to attach the superscript (or exponent) to the *c*. To do this, click on the ▓˙ icon in the Small Bar. This will create a superscript slot next to the c, as shown below:

$$y = \sqrt{\tfrac{3}{16}} \sin x - c^{\square}$$

13. Type **2**, and then press TAB to move the insertion point out of the superscript slot, into the position shown below:

$$\underline{y = \sqrt{\tfrac{3}{16}} \sin x - c^2}$$

14. Click on the ± in the Small Bar. MathType knows that the ± symbol is supposed to have spaces around it in this situation, so, as usual, you don't have to type them.

15. Choose the μ from the $\boxed{\lambda\ \omega\ \theta}$ palette — it's the second one from the right in the row of Symbol Palettes. Alternatively, as the Greek letter µ corresponds to the letter m, you can press CTRL+G, followed by **m**. Your equation should look like this:

$$y = \sqrt{\tfrac{3}{16}} \sin x - c^2 \pm \mu$$

16. Finish the formula by typing **tanx**. Again, notice that MathType uses plain (instead of italic) type for the tan function and puts thin spaces on either side of it. Your finished equation should look like this:

$$y = \sqrt{\tfrac{3}{16}} \sin x - c^2 \pm \mu \tan x$$

17. Close the MathType window, either by clicking on its close box or by choosing the Close and return to <document> command on the File menu, and choose Yes in response to the dialog that asks if you want to save changes. This will insert your equation into the Word document in "displayed" form (on a line by itself), like this

$$y = \sqrt{\tfrac{3}{16}} \sin x - c^2 \pm \mu \tan x$$

18. In other situations, you might want to embed an equation within a line of text, for example $y = \sqrt{\frac{3}{16}} \sin x - c^2 \pm \mu \tan x$, rather than displaying it on a line by itself. To do this, use the Insert Inline Equation command from Word's MathType menu or MathType toolbar.

Tutorial 2: Sums, Subscripts & Superscripts

In this tutorial we'll create the formula that is often used to calculate a statistical quantity known as variance. The formula is:

$$\sigma_X^2 = \frac{1}{n} \left\{ \sum_{i=1}^{n} X_i^2 - n\bar{X}^2 \right\}$$

This formula illustrates the use of subscripts, superscripts, and summation templates. Integral and product templates behave much the same as summation templates, so what you learn in this tutorial will be useful in a variety of other situations. The steps required to create the formula are as follows:

1. Open a new Word document, and type a few lines of text.

2. Choose the Insert Display Equation command from Word's MathType menu or MathType toolbar. This will open a MathType window, ready for you to start creating the equation.

3. Enter a σ. One way to do this is to choose it from the $\boxed{\lambda\,\omega\,\theta}$ palette. Alternatively, you could use its keyboard shortcut. The keyboard shortcuts for toolbar items are displayed in the status bar as you move the mouse over them. In this case you can press CTRL+G followed by **s**.

4. Next, create slots for the subscript and superscript on the σ by clicking on the ▦ icon in the Small Bar. Subscripts and superscripts are rather small. In order to better see what's happening, make sure you've chosen at least 200% viewing scale in the Zoom submenu of the View menu.

Zoom Levels
A quick way to change zoom level is to right-click in the Zoom panel on the status bar. Or, you can type: CTRL+1 for 100%, CTRL+2 for 200%, CTRL+4 for 400%, or CTRL+8 for 800%.

5. The insertion point will be located in the newly created subscript slot. Type the subscript, **X**.

6. Move the insertion point up into the superscript slot either by clicking in it or by pressing the TAB key. Then type the number **2** into the superscript slot.

7. Now let's move the insertion point to the location shown below:

$$\sigma_X^2 \big|$$

Either press the TAB key, or click somewhere out to the right of the equation, as shown in the picture. Be careful not to place the pointer too close to the subscript or superscript slots, or else the insertion point may jump into one of them when you click.

8. Type in the = sign. Remember not to type any spaces.

9. Construct the fraction by using the full-size ⊞ template, which is available in the Small Bar and in the ⊞√▯ palette. Be careful — it's not the same template as the ▤ fraction template that we used in Tutorial 1.

10. The insertion point will be located in the newly created numerator slot; type the number **1** into this slot.

11. Move the insertion point down into the denominator slot either by clicking in it or by pressing the TAB key. Then type in the denominator, **n**, and press the TAB key again to move the insertion point out of the denominator slot. Your equation should now look like this:

$$\sigma_X^2 = \frac{1}{n}$$

12. Next we need to insert a pair of braces (curly brackets). You can do this either by clicking on the {▯} icon in the palette, or by using the CTRL+{ keyboard shortcut. Remember that { is a shifted character on standard keyboards, so you'll actually need to hold down the CTRL and SHIFT keys while pressing the key that bears the [and { characters.

13. Click on the $\sum_▯^▯$▯ icon to enter a summation template inside the braces. Notice how the braces expand automatically. Your equation should now look like this:

$$\sigma_X^2 = \frac{1}{n}\left\{\sum \Box\right\}$$

14. Type the letter **X** into the summand slot (the large slot on the right).

15. Attach a subscript and superscript to the X, using the ▦⋮ template. Fill in the subscript and superscript slots with **i** and **2**, respectively.

16. Move the insertion point into the lower limit slot of the summation template by clicking inside the slot, and type **i=1**. As usual, do not type any spaces. MathType will automatically reduce the size of the text, and will center it below the summation sign. In this case, MathType will not insert any spaces around the = sign, since it is in the limit of a summation. Again, this is a standard typesetting convention that you can override if you want to.

17. Click in the upper limit slot of the summation template, and type in the upper limit, **n**.

18. Move the insertion point into the position shown below:

$$\sigma_X^2 = \frac{1}{n}\left\{\left[\sum_{i=1}^{n} X_i^2\right]\right\}$$

If the insertion point is in the upper limit slot of the summation template, pressing the TAB key will do the trick. In fact, as we saw in Tutorial 1, if you keep pressing the TAB key, the insertion point will cycle through all the slots in the equation and will eventually reach the position shown, regardless of where it started out. If you want to move the insertion point by clicking, click somewhere near the point indicated by the arrow in the picture above. You might want to use the Show Nesting command on the View menu to make this easier.

19. Type **–nX**.

20. Place a bar over the X by clicking on the ⸫ icon in the ⸫ palette. In MathType, embellishments of this type are always added to the character to the left of the insertion point. You can even add several embellishments to the same character. For more details, look for Embellishments in MathType's online help.

21. Enter the superscript 2 by using the ⸫ template. It works just the same way as the ⸫ template that we used earlier. The equation is now complete (well, maybe it is — see the next step below).

22. We hope you're happy with the way MathType formats your equation, but, if you're not, we've provided a way for you to make some fine adjustments of your own. You can select any item or group of items, in the usual way, and nudge them either horizontally or vertically in steps of one pixel (screen dot). If you view your equation at 800% scale you can make adjustments as small as an eighth of a point.

To nudge items, use the following keystrokes:

CTRL+←	nudges the selected items to the left by one pixel
CTRL+↑	nudges the selected items upward by one pixel
CTRL+→	nudges the selected items to the right by one pixel
CTRL+↓	nudges the selected items downward by one pixel

Selecting an Embellishment
You can select an embellishment by holding down the CTRL key and then clicking on the embellishment.

You might want to try moving a subscript or a superscript, moving the limits of the summation, or even moving the bar embellishment.

Keep in mind, however, that nudging is really intended for making small adjustments that cannot be achieved otherwise. The preferred method for adjusting spacing is using the Define Spacing dialog, described in Chapter 7. This approach has the advantage that the spacing rules you define affect all equations.

23. Close the MathType window, which will insert the equation into your Word document. Save the document, because we're going to use it in the next tutorial.

Tutorial 3: Editing Old Equations

This tutorial teaches you some special editing techniques that are useful when you're modifying an existing equation. You will often need to correct a mistake in an old equation, or make a new one that is a slight variation of one that you have made in the past. Instead of starting from scratch, you can bring a copy of the old equation back into MathType and modify it as needed. In this way, all your old documents serve as sources of material for new documents. You can store commonly used equations (or fragments of equations) in word processing documents or as expressions within MathType itself.

Let's suppose that the equation we created in Tutorial 2 is the wrong one, and we want to use the following related formula in our document instead:

$$s_X = \sqrt{\frac{1}{n-1}\left\{\sum_{i=1}^{n} X_i^2 - n\bar{X}^2\right\}}$$

The steps required are as follows:

1. Open the Word document containing the equation you created in Tutorial 2 above. We want to bring this equation back into MathType for editing. There are several ways to do this, as explained in Chapter 5, but the simplest is to double-click on it. This will open the equation for editing, in a new MathType window.

2. Select the term on the left-hand side of the equation by dragging the arrow pointer across it while holding down the left mouse button. The selected items will be highlighted by black-white reversal, in the usual Windows manner. It should look like this:

$$\sigma_X^2 = \frac{1}{n}\left\{\sum_{i=1}^{n} X_i^2 - n\bar{X}^2\right\}$$

3. Delete the selected items by using the Clear command on the Edit menu, or by pressing the BACKSPACE key or the DELETE key.

4. The insertion point is in the right place, immediately to the left of the = sign, so you can now enter the new left-hand side. Type in the letter **s** and attach the X subscript to it by using the ▨▪ template, in the usual way.

5. Next, we're going to enclose the right-hand side in a square root sign. We're going to "wrap" a $\sqrt{}$ template around the existing terms — previously we have always inserted templates first, and then filled in their slots afterwards. Select

the entire right-hand side of the equation, watching the highlighting carefully to see that your selection is correct. It should look like this:

$$s_X = \frac{1}{n}\left\{\sum_{i=1}^{n} X_i^2 - n\overline{X}^2\right\}$$

Now click on the $\sqrt{}$ icon in the Small Bar. The $\sqrt{}$ template will be inserted into your equation and automatically wrapped around the selected items. When you insert a template, MathType always wraps it around any selected items.

6.   You might be wondering how you would do the reverse of the operation we performed in step 5 — suppose you had an expression enclosed in a square root sign (or some other template) and you wanted to remove the square root sign but keep the expression. To do this, you first select the expression under the square root sign and choose Cut to transfer it to the Clipboard. Next, select the (now empty) square root sign, and press BACKSPACE or DELETE to remove it. Finally, choose Paste to bring the expression back from the Clipboard.

7.   Finally, we have to change the n in the denominator of the fraction to $n - 1$. Position the insertion point in the denominator slot, to the right of the n, by clicking near the point indicated by the arrow pointer in the picture below:

$$s_X = \sqrt{\frac{1}{n}\left\{\sum_{i=1}^{n} X_i^2 - n\overline{X}^2\right\}}$$

Then, simply type **–1** to change the denominator.

Color
You can customize the Color menu using the Edit Color Menu command in the Color submenu.

8.   Let's now suppose we want to change the color of the term s_X from black to red. Select the term using the mouse, and then choose the Color command on the Format menu. A submenu appears containing a list of colors. Choose Red and release the mouse. The selected term will become red (you will have to click outside the equation to de-select the term in order to see the new color).

9.   We're finished editing the equation, so close the MathType window. If a dialog appears asking if you want to save your changes, click Yes. Once the MathType window has closed, your word processor will become active and you'll see that your document now contains the modified equation.

Tutorial 4: Including Text in an Equation

In our next tutorial, we show you how to enter words and phrases in an equation, and also how to handle function name abbreviations that MathType does not recognize. We are going to create the following equation:

$$\text{Prob}(A \mid B) \;=\; \frac{\text{Prob}(A \cap B)}{\text{Prob}(B)} \;=\; \frac{\text{Probability that } \mathbf{both}\; A \text{ and } B \text{ occur}}{\text{Probability that } B \text{ occurs}}$$

1. First, open a new MathType window using one of the methods you've already learned. Then type **Prob(A|B)**. The result will be

$$\Pr ob(A \mid B)$$

Controlling Italics
To assign regular (non-italic) style to function names, use Function on the Style menu, rather than just removing the italics.

Using its built-in table of function names, MathType has recognized Pr as an abbreviation for "probability" and set it in the Function style, while o and b are regarded as variables. In this tutorial, we want to use Prob, rather than just Pr, as our abbreviation for "probability". You might think that you can fix the problem by just making the o and b non-italic, but we don't recommend this. If you simply remove the italicization, MathType will still regard o and b as variables, which is not what we intend. The right approach is to select Prob and choose Function from the Style menu. This will remove the italics, but it also tells MathType that Prob is the name of a function, which will affect spacing and translation into languages such as L^AT_EX and MathML.

Copying and Dragging
To re-use part of an existing equation, select the part and then use the Copy and Paste commands, or drag and drop. Hold down the Control key when dragging to copy the selection.

2. Create the fraction in the middle term of the equation. You can copy and paste $\text{Prob}(A \mid B)$, and modify it for re-use in the numerator and denominator. You can find $\cap$, the set intersection symbol, on the [$\notin \cap \subset$] palette. Your equation should now look like

$$\text{Prob}(A \mid B) \;=\; \frac{\text{Prob}(A \cap B)}{\text{Prob}(B)} \;=$$

3. Construct the fraction on the right-hand side of the equation by using the ▦ template again. The insertion point will be positioned in the numerator, ready to type the text.

Typing Text
Before typing normal words and phrases, choose Text from the Style menu.

4. If you just start typing characters into the numerator slot, MathType will assume that they are variables, so they will be italicized, and any spaces you type will be ignored. To type ordinary words and phrases, you should first choose Text from the Style menu. Then type **Probability that both A and B occur**. The numerator of our fraction will look like this:

$$\text{Probability that both A and B occur}$$

This is what we want, except that the word "both" should be bold and the A and B should be italic.