

## Tables in L<sup>A</sup>T<sub>E</sub>X Documents

Making tables in L<sup>A</sup>T<sub>E</sub>X is not as hard as some people make it out to be. There are, however, lots of bells and whistles you can include in a table, and sometimes finding out how to make it all work can be difficult. Fortunately, if you're just looking for basic table formatting, there's only two or three tricks you need to know.

Before we get any deeper, you need to understand one thing:

*Overriding default cell-dimensions in L<sup>A</sup>T<sub>E</sub>X tables takes talent.*

This can be an annoyance, but it has to be this way for a good reason. I'll show you the basics of column- and row-stretching in this handout.

### Getting Started

When you typeset a table in L<sup>A</sup>T<sub>E</sub>X, you have to specify the appearance of the table yourself. This includes the existence of bounding boxes, horizontal lines between rows, vertical lines between columns, and the alignment of the text in the cells. For instance, do you want your table to look like this

$f(x)$	$f'(x)$	$f''(x)$
$\sin x$	$\cos x$	$-\sin x$
$\tan x$	$\sec^2 x$	$2\sec^2 x \tan x$

or would you prefer this

$f(x)$	$f'(x)$	$f''(x)$
$\sin x$	$\cos x$	$-\sin x$
$\tan x$	$\sec^2 x$	$2\sec^2 x \tan x$

instead? I can even do this

$f(x)$	$f'(x)$	$f''(x)$
$\sin x$	$\cos x$	$-\sin x$
$\tan x$	$\sec^2 x$	$2\sec^2 x \tan x$

if I want, and none of this is hard. Before we start talking about table mark-up, make sure you keep in mind the following points:

- The width of a column is set by default to fit the contents of the cells. This can be altered, but it sometimes involves guess-and-check.
- In general, the tabular environment in L<sup>A</sup>T<sub>E</sub>X is very “column-centric.” You specify and control all things related to columns, but not much about the rows.
- The tabular environment expects the cells to consist of *text*. If this is not the case (like in my derivative tables above) you must specify your mathematical symbols with \$ signs *for each cell* containing mathematics.
- When you mark-up a table, L<sup>A</sup>T<sub>E</sub>X essentially creates your table as if it were one large symbol. So if you want to center it in the page, you can, but you have to surround it with a centered environment (center before and after the table mark-up, *not* in-between).

## Basic Table Formatting

Before you do anything, you need to make several decisions:

1. How many columns do you need?
2. Do you want vertical lines separating the columns? All? Some? None?
3. Do you want vertical lines on the outside “margins” of your table? (Compare my first table above to the second.)
4. How do you want the contents of each column aligned? Left? Centered? Right?

Once you have settled these questions, you can begin. The `tabular` environment is called up with `\begin{tabular}` (and you know how it ends). The next thing you do is specify some parameters that depend upon your answers to the four questions above. Suppose I want to create this table:

<b>Name</b>	<b>Field</b>	<b>Ph.D. Institution</b>
Keith	Discrete Math	U. of Delaware
Randall	Category Theory	U. of Virginia
Janusz	Semigroup Theory	Penn State

With respect to the “four questions,” this has three columns, vertical lines between each, no vertical lines on the margins, and centered contents. All of this specified by (and this is the important part)

```
\begin{tabular}{c|c|c}
```

The `c` stands for *center*, not column. This tells L<sup>A</sup>T<sub>E</sub>X that I want a centered column, then a vertical line the height of the whole table, then another centered column, then the next vertical separator, and then a final centered column.

Next, I enter my data. Cells on a row are column-separated by an ampersand `&`, and rows are broken with a double backslash `\\` (also: don’t forget to break the final row). If you ever want a horizontal line between rows, typeset `\hline` after the first row’s rowbreak and before the second row begins. For example, I created the table above with the following mark-up:

```
\begin{tabular}{c|c|c}
\textbf{Name} & \textbf{Field} & \textbf{Ph.D. Institution} \\ \hline
Keith & Discrete Math & U. of Delaware \\
Randall & Category Theory & U. of Virginia \\
Janusz & Semigroup Theory & Penn State \\
\end{tabular}
```

With a little bit of imagination, you can guess how to adjust these parameters. Suppose I want all the column contents to be left-aligned, as in

<b>Name</b>	<b>Field</b>	<b>Ph.D. Institution</b>
Keith	Discrete Math	U. of Delaware
Randall	Category Theory	U. of Virginia
Janusz	Semigroup Theory	Penn State

Well, I just use `\begin{tabular}{l|l|l}` instead. Maybe I want the first column flushed left, the middle one centered, and the last one flushed right. Easy enough: calling up the environment as `\begin{tabular}{l|c|r}` creates

<b>Name</b>	<b>Field</b>	<b>Ph.D. Institution</b>
Keith	Discrete Math	U. of Delaware
Randall	Category Theory	U. of Virginia
Janusz	Semigroup Theory	Penn State

Admittedly this looks pretty stupid, but the point is that you could do it if you ever wanted to.

You now know how to create horizontal and vertical separators. From this, you should be able to guess how to manufacture this table:

<b>Name</b>	<b>Field</b>	<b>Ph.D. Institution</b>
Keith	Discrete Math	U. of Delaware
Randall	Category Theory	U. of Virginia
Janusz	Semigroup Theory	Penn State

How do we get the vertical marginal bars? You guessed it: `\begin{tabular}{|c|c|c|}` (compare to the previous example without the marginal bars). All we need now is a horizontal line *before* the first row, one right after the first row, and one after the *last* row. Here’s the code that created the previous table:

```
\begin{tabular}{|c|c|c|} \hline
\textbf{Name} & \textbf{Field} & \textbf{Ph.D. Institution} \\ \hline
Keith & Discrete Math & U. of Delaware \\
Randall & Category Theory & U. of Virginia \\
Janusz & Semigroup Theory & Penn State \\ \hline
\end{tabular}
```

There are obvious variations on all this as well. For example, to get

<b>Name</b>	<b>Field</b>	<b>Ph.D. Institution</b>
Keith	Discrete Math	U. of Delaware
Randall	Category Theory	U. of Virginia
Janusz	Semigroup Theory	Penn State

one would start out with `\begin{tabular}{|c||c|c|}`. Also, you are not required to have column separators at all! In fact, this sometimes produces snazzier results. For instance, using `\begin{tabular}{|c|c c|}` would produce

<b>Name</b>	<b>Field</b>	<b>Ph.D. Institution</b>
Keith	Discrete Math	U. of Delaware
Randall	Category Theory	U. of Virginia
Janusz	Semigroup Theory	Penn State

### Fixing Column Widths

Often you will want to have more control over the widths of some or all of your columns. For example, you may want them all to have the same width. For this there is a different parameter for the tabular environment, namely the “p column specifier.” This parameter takes an argument which is the desired width of the particular column. For example, if I want a column to have width 1.5 inches, I would use `p{1.5in}` for my column declaration. How do you know what this width should be? Guess, check, and adjust.

IMPORTANT NOTE: The default alignment for the p column specifier is *flush left*. If you don’t want this, you have to override this for *each* cell in that column. (Examples will follow.)

Suppose (for some reason) I want this kind of table:

Name	Field	Ph.D. Institution
Keith	Discrete Math	U. of Delaware
Randall	Category Theory	U. of Virginia
Janusz	Semigroup Theory	Penn State

Here, the first column is 2 inches wide, while the last two are under the default setting of fit-to-contents. I marked up this table with `\begin{tabular}{|p{2.0in}|1|1|}`.

Maybe I want the same column spacing but I *really* want everything centered, as in

Name	Field	Ph.D. Institution
Keith	Discrete Math	U. of Delaware
Randall	Category Theory	U. of Virginia
Janusz	Semigroup Theory	Penn State

You can center the last two columns as usual, but you have to force the centering for the first column (since it is specified by the `p` parameter). So we start with `\begin{tabular}{|p{2.0in}|c|c|}`, as usual. To force the centering in the first column, we must precede *each entry* in that column with the command `\centering`. Here's the code that produced that last table:

```
\begin{tabular}{|p{2.0in}|c|c|} \hline
\centering \textbf{Name} & \textbf{Field} & \textbf{Ph.D. Institution} \\ \hline
\centering Keith & Discrete Math & U. of Delaware \\
\centering Randall & Category Theory & U. of Virginia \\
\centering Janusz & Semigroup Theory & Penn State \\ \hline
\end{tabular}
```

Finally, what if you would like all columns to have the *same* width? Here's how I do it. First, typeset the table with flush-left contents as `\begin{tabular}{|1|1|...|1|}` (however many columns you need). Look at the output and ballpark the width of the *widest* column. Suppose this is  $x.y$  inches. Now go back and replace every `1` with `p{x.yin}`. Recompile, see how it looks, and adjust if necessary.

### Fixing Row Heights

This is super easy, *as long as you want uniform heights throughout your table*.<sup>1</sup> This is an especially handy thing to be able to do if your cells contain “tall” mathematics, like integral symbols. Let's look at an example. The following table was typeset with default settings in a `\begin{tabular}{|1|1|}` environment:

Fundamental Theorem	$\int_a^b f(x) dx = F(b) - F(a)$
Green's Theorem	$\oint_{\partial D} \langle P, Q \rangle \cdot d\mathbf{r} = \iint_D Q_x - P_y dA$

What a disaster. How do we fix this?

Internal to every  $\text{\LaTeX}$  document class is a parameter called `\arraystretch` that controls row heights in various figures (tables, for example). All we have to do is *temporarily* override this parameter's setting so that it does “more than” its default. The default is always 1.0, and the

<sup>1</sup>If you don't, I'm not sure what to tell you. Look it up.

parameter is adjusted in proportion to this unit. So, if you want it to do 50% more than what it's coded for, we would adjust the parameter to 1.5. Adjustments to default settings for parameters is done with the `\renewcommand` string.

Using this, we fix our table above by coding the following

```
\renewcommand{\arraystretch}{2.5}
\begin{center}
\begin{tabular}{|l|l|} \hline
Fundamental Theorem &  $\int_a^b f(x) \, dx = F(b) - F(a)$  \\ \hline
Green's Theorem &  $\oint_{\partial D} \langle P, Q \rangle \cdot d\mathbf{r} = \iint_D Q_x - P_y \, dA$  \\ \hline
\end{tabular}
\end{center}
\renewcommand{\arraystretch}{1.0}
```

which produces

Fundamental Theorem	$\int_a^b f(x) \, dx = F(b) - F(a)$
Green's Theorem	$\oint_{\partial D} \langle P, Q \rangle \cdot d\mathbf{r} = \iint_D Q_x - P_y \, dA$

Note what I've done here. I adjusted the parameter *before* I did anything table-related, blowing it up by a factor of 2.5. When I'm finished marking up my table, *I then reset the parameter back to its default*. If I don't do this, future tables will be set with the same adjustment, which may not be the desired effect.