# The **skmath** package*†

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Version 0.5

Abstract The skmath package provides improved and new math commands for superior typesetting with less effort.

## 1 Introduction

This package intends to provide helpful (re-)definitions of commands related to typesetting mathematics, and specifically typesetting them in a more intuitive, less verbose and more beautiful way. It was originally not intended for use by the public, and as such there may be incompatibilities with other packages of which I am not aware, but I figured it could be useful to other people as well.

## 2 Usage

### 2.1 Options

As of version v0.5, the package provides two key-value options.

`commonsets` `true,false` `(false)`
Optionally define `\N`, `\Z`, `\Q`, `\R` and `\C` as blackboard variants of the respective letters, to represent the common sets of numbers.

`notation` `iso,english,german,legacy` `(legacy)`
This option controls the style of a few typographic elements that differ between countries and standards (such as the style of integrals, derivatives and greek letters).

*Available on `http://www.ctan.org/pkg/skmath`.
†Development version available on `https://github.com/urdh/skmath`.

## 2.2 New commands

The package defines a number of new commands that aid in typesetting certain mathematical formulae.

**\N**
**\Z**
**\Q**
**\R**
**\C**

These commands are only available if the `commonsets` option is given. They typeset the set of natural, integer, rational, real and complex numbers respectively.

**Example:**

$$\mathbb{N}, \mathbb{Z}, \mathbb{Q}, \mathbb{R}, \mathbb{C}.$$

```
\begin{equation*}
  \N, \Z, \Q, \R, \C.
\end{equation*}
```

**\ii**
**\jj**

These commands typeset the imaginary unit (either $i$ as used in mathematics or $j$ as used in electrotechnology). While normal use of the package simply results in italic characters, setting the `notation` option to `iso` will set these upright.

**\ee**

This command typesets Euler's number $e = \sum_{n=0}^{\infty} \frac{1}{n!}$. The style is affected by the `notation` option in the same way as **\exp**.

`\norm` {⟨*expression*⟩}
`\abs` {⟨*expression*⟩}

The commands **\norm** and **\abs**, quite expectedly, typeset the norm ans absolute value of an expression, respectively. They have one mandatory argument (the expression), and different norms can be achieved by appending a subscript after the argument of **\norm**.

**Example:**

$$\|\boldsymbol{x}\|_p = \left(\sum_{i=1}^{n}|x_i|^p\right)^{1/p}$$

```
\begin{equation*}
  \norm{\vec{x}}_p =
    \left(\sum_{i=1}^n \abs{x_i}^p\right)%
      ^{\sfrac{1}{p}}
\end{equation*}
```

`\d` {⟨*variable*⟩}

There is also a command **\d**, with one mandatory argument, that typesets the differential part of an integral.

**Example:**

$$\int_{\mathbb{R}} \frac{\sin{(x)}}{x}\,\mathrm{d}x$$

```
\begin{equation*}
  \int_{\R}\! \frac{\sin{x}}{x} \d{x}
\end{equation*}
```

`\pd` ⋆{⟨*function*⟩}{⟨*var*⟩,⟨*var*⟩,...}

This macro typesets a partial derivative. The starred variant typesets derivatives as subscripts, i.e. $f_{xxy}$, while the unstarred variant typesets full fractions:

**Example:**

$$\frac{\partial^{m+n} f}{\partial x^m \partial y^n}$$

```
\begin{equation*}
  \pd{f}{x^m,y^n}
\end{equation*}
```

As the example shows, the comma-separated list of variables also supports superscripts to denote the number of derivatives, and the sum of the variables is automatically calculated.

**\td** {⟨*function*⟩}{⟨*var*⟩}

This macro typesets a total derivative. Unlike **\pd**, this macro does not have a starred variant, and only typesets full fractions:

**Example:**

$$\frac{d^m f}{dx^m}$$

```
\begin{equation*}
  \td{f}{x^m}
\end{equation*}
```

**\E** {⟨*expression*⟩}

The command **\E** typesets the expectation of a random variable.

**Example:**

$$\mathrm{E}\left[\hat{\mu}\right] = \mu$$

```
\begin{equation*}
  \E{\hat{\mu}} = \mu
\end{equation*}
```

**\P** {⟨*expression*⟩**\given**⟨*expression*⟩}

The **\P** command typesets a probability. The **\given** command can be used to typeset conditional probabilities, within **\P**.

**Example:**

$$\mathrm{P}(A \mid B) = \frac{\mathrm{P}(B \mid A)\,\mathrm{P}(A)}{\mathrm{P}(B)}$$

```
\begin{equation*}
  \P{A\given B} =
    \frac{\P{B\given A}\P{A}}{\P{B}}
\end{equation*}
```

`\var` {⟨*expression*⟩}
`\cov` {⟨*expression*⟩}{⟨*expression*⟩}

The commands **\var** and **\cov** typeset the variance and covariance of an expression.

**Example:**

$$\begin{gathered}\mathrm{Var}\,(X) = \mathrm{E}\left[(X-\mu)^2\right] \\ \mathrm{Cov}\,(X,Y) = \mathrm{E}\,[XY] - \mathrm{E}\,[X]\,\mathrm{E}\,[Y]\end{gathered}$$

```
\begin{gather*}
  \var{X} = \E{(X-\mu)^2}\\
  \cov{X}{Y} = \E{XY}-\E{X}\E{Y}
\end{gather*}
```

## 2.3 Improved commands

In addition to adding new commands, this package also redefines already existing commands in a mostly backwards-compatible way to improve their usefulness.

`\sin` [⟨*power*⟩]{⟨*expression*⟩}
`\arcsin` {⟨*expression*⟩}
`\cos` [⟨*power*⟩]{⟨*expression*⟩}
`\arccos` {⟨*expression*⟩}
`\tan` [⟨*power*⟩]{⟨*expression*⟩}
`\arctan` {⟨*expression*⟩}
`\cot` [⟨*power*⟩]{⟨*expression*⟩}
`\sinh` [⟨*power*⟩]{⟨*expression*⟩}
`\cosh` [⟨*power*⟩]{⟨*expression*⟩}
`\tanh` [⟨*power*⟩]{⟨*expression*⟩}

The trigonometric functions have been redefined to typeset more easily. They typeset ⟨*expression*⟩ as an argument of the expression, and (if applicable) ⟨*power*⟩ as a superscript between the function and its argument, *e.g.* $\sin^2(\phi)$. When the argument is empty, no parentheses are emitted: $\cos$.

`\ln` {⟨*expression*⟩}

The natural logarithm macro **`\ln`** has also been redefined to require an argument which is typeset as the argument of the logarithm.

`\log` [⟨*base*⟩]{⟨*expression*⟩}

The related macro **`\log`** is redefined in a similar way, but also accepts an optional argument denoting the base of the logarithm: $\log_2(x)$. As with the trigonometric functions, no parentheses are emitted if the mandatory argument is empty: $\log$.

`\exp` *{⟨*expression*⟩}

The exponential, **`\exp`**, is redefined to typeset its argument as a superscript of $e$ in some display styles, and as an argument of $\exp$ otherwise:

$$e^{\sqrt{2}\exp(x)}$$

Additionally, it is possible to force the $\exp$ mode by using the starred variant.

**\min** ⋆[⟨*domain*⟩]{⟨*expression*⟩}
**\argmin** ⋆[⟨*domain*⟩]{⟨*expression*⟩}
**\max** ⋆[⟨*domain*⟩]{⟨*expression*⟩}
**\argmax** ⋆[⟨*domain*⟩]{⟨*expression*⟩}
**\sup** ⋆[⟨*domain*⟩]{⟨*expression*⟩}
**\inf** ⋆[⟨*domain*⟩]{⟨*expression*⟩}

The maximum/minimum macros have been redefined in a manner similar to the trigonometric functions. They typeset ⟨*expression*⟩ inside curly brackets (the starred version omits the brackets), with the optional ⟨*domain*⟩ typeset in a subscript after the operator (*e.g.* $\min_{x\in\mathbb{R}_+} f(x)$). Argument variants are also provided, and the ⟨*expression*⟩ is centered underneath the operator if possible:

$$\arg\min_{x\in\mathbb{R}_+} f(x)$$

## 2.4 Stylistic changes

Some commands have been redefined in a completely backwards-compatible way to improve the end result of their typesetting.

**\frac** {⟨*numerator*⟩}{⟨*denominator*⟩}

The **\frac** command has been changed to improve typesetting, allowing displaystyle math in some settings.

**\bar** {⟨*expression*⟩}
**\vec** {⟨*expression*⟩}

The **\bar** command has been changed to cover the entire ⟨*expression*⟩ (*i.e.* $\overline{uv}$), and **\vec** has been changed to match the `\vectorsym` command provided by isomath.

**\Re** {⟨*expression*⟩}
**\Im** {⟨*expression*⟩}

These commands typeset the real and imaginary part of a number. Standard use of the package takes definitions roughly from amsmath, while

setting the `notation` option to `iso` changes the definitions to match ISO 80000-2.

## 3 Known issues

A list of current issues is available in the Github repository of this package[1], but as of the release of v0.5, there is one known issue.

#15 The package is incompatible with (at least) blindtext, when including math in the blind text. This is due to the redifinition of `\sin` (and friends), which is incompatible with the original amsmath definition. This is a feature, not a bug.

If you discover any bugs in this package, please report them to the issue tracker in the skmath Github repository.

[1] `https://github.com/urdh/skmath/issues`

## 4 Installation

The easiest way to install this package is using the package manager provided by your LaTeX installation if such a program is available. Failing that, provided you have obtained the package source (`skmath.tex` and `Makefile`) from either CTAN or Github, running `make install` inside the source directory works well. This will extract the documentation and code from `skmath.tex`, install all files into the TDS tree at `TEXMFHOME` and run `mktexlsr`.

If you want to extract code and documentation without installing the package, run `make all` instead. If you insist on not using `make`, remember that packages distributed using skdoc must be extracted using `pdflatex`, *not* `tex` or `latex`.

## 5 Changes

v0.1

General: Initial version.

v0.1c

General: Moved package from docstrip to skdoc.

v0.1d

General: Fixed fatal documentation and package errors.

v0.1e

General: Added statistics commands.

v0.1g

General: Documentation fixes.

v0.2

General: Use expl3 functionality throughout the package.

v0.3

General: Added `\min`/`\max` and friends. Added `\pd`.

v0.3a

General: Added `\sinh`, `\cosh` and `\tanh`.

v0.3b

General: Detect empty arguments in trigonometric and logarithmic functions, fix `\ln`.

v0.4

General: Added `notation` option, macros for complex numbers.

v0.4a

General: Replaced deprecated/removed expl3 constructs.

v0.4b

General: Track expl3 changes (thanks to Joseph Wright).

v0.5

General: Added `\td`.

## 6 Index

Numbers written in italic refer to the page where the corresponding entry is described; numbers underlined refer to the page were the implementation of the corresponding entry is discussed. Numbers in roman refer to other mentions of the entry.