

# Writing derivatives

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## Abstract

This document describes the package `esdiff` that makes writing derivatives very easy. It allows to write derivatives, partial derivatives, multiple derivatives. Some typographic options are available. The macro about crossed derivatives was given on `comp.text.tex` by Peter Schmitt.

## 1 Derivatives

`\diff`

Derivatives are obtained with the command `diff`.

To get  $\frac{df}{dx}$ , just write  `$\diff{f}{x}$`.

The order of the derivative can be set in square brackets. So  `$\diff[n]{f}{x}$` gives  $\frac{d^n f}{dx^n}$ .

`\diff*`

It's easy to precise the point where the derivative is calculated:

`$\diff*{f}{x}{x_0}$` gives  $\left(\frac{df}{dx}\right)_{x_0}$ .

Of course, those two options can be used together:  `$\diff*[2]{g}{y}{0}$` gives as expected  $\left(\frac{d^2 g}{dy^2}\right)_0$ .

## 2 Partial derivatives

`\diffp`

Partial derivatives are obtained with the macro `diffp`, using the same syntaxe as with `diff`: a star version to put a subscript, and square brackets to set the order of the derivative according to only one variable.

To get  $\frac{\partial f}{\partial x}$ , just write  `$\diffp{f}{x}$`.

We obtain  $\frac{\partial^2 f}{\partial x^2}$  wrtiting  `$\diffp[2]{f}{x}$`.

`\diffp*`

The notation  $\left(\frac{\partial p}{\partial V}\right)_T$  is the result of  `$\diffp*{p}{V}{T}$`.

The notation of crossed derivatives is automatic. To get  $\frac{\partial^3 f}{\partial x \partial y^2}$ , write  `$\diffp{f}{x}{y^2}$`. This method can be used to write a partial derivative, without square brackets. So  `$\diffp{f}{x^2}$` gives  $\frac{\partial^2 f}{\partial x^2}$ .

We can mix options: `\diffp*{f}{x^2}{y^3}{z}` gives  $\left(\frac{\partial^5 f}{\partial x^2 \partial y^3}\right)_z$ .

### 3 Options

Several options are available:

- by default, derivatives are written in `displaystyle` on text mode. The `display` option set this default. With the `text` option, derivatives are written in `textstyle` on text mode;
- by default, the `d` of the derivative is written in roman. Available options are `roman` and `italic`;
- we can set the space between the `d` and the symbol of the function or of the variable. By default, this space is null. Available options are `thin`, `med` and `big`. It may be fine to add a space when the `d` is in italic;
- We can set the space between the  $\partial$  and the symbol of the function or of the variable. By default, this space is null. Available options are `thinp`, `medp` and `bigp`;
- the space between  $\partial x$  and  $\partial y$  in crossed derivatives may be too narrow. It is null by default. Available options are `thinc`, `medc` and `bigc`;

### 4 The code

The package presents itself.

```
1 \*package
2 \NeedsTeXFormat{LaTeX2e}
3 \ProvidesPackage{esdiff}
```

We set default values for the options.

```
4 \newcommand{\taille}[1]{\displaystyle{#1}}
5 \newcommand{\difint}{\mkern 0mu}
6 \newcommand{\derpint}{\mkern 0mu}
7 \newcommand{\croisint}{\mkern 0mu}
```

The `d` is roman by default..

```
8 \newcommand{\dop}{\mathrm{d}}
```

Options:

```
9 \DeclareOption{display}{\renewcommand{\taille}[1]{\displaystyle{#1}}}
10 \DeclareOption{text}{\renewcommand{\taille}[1]{\textstyle{#1}}}
11 \DeclareOption{roman}{\renewcommand{\dop}{\ensuremath{\mathrm{d}}}}
12 \DeclareOption{italic}{\renewcommand{\dop}{\ensuremath{\mathrm{d}}}}
13 \DeclareOption{thin}{\renewcommand{\difint}{\ensuremath{\,}}}
14 \DeclareOption{med}{\renewcommand{\difint}{\ensuremath{\;}}}
15 \DeclareOption{big}{\renewcommand{\difint}{\ensuremath{\;}}}
16 \DeclareOption{thinp}{\renewcommand{\derpint}{\ensuremath{\,}}}
17 \DeclareOption{medp}{\renewcommand{\derpint}{\ensuremath{\;}}}
18 \DeclareOption{bigp}{\renewcommand{\derpint}{\ensuremath{\;}}}
19 \DeclareOption{thinc}{\renewcommand{\croisint}{\ensuremath{\,}}}
20 \DeclareOption{medc}{\renewcommand{\croisint}{\ensuremath{\;}}}
```

```

21 \DeclareOption{bigc}{\renewcommand{\croisint}{\ensuremath{\cdot}}}
22 \ProcessOptions\relax

```

## 4.1 Derivative

Test of star version.

```
23 \def\diff{\@ifstar{\diffstar}{\diffnostar}}
```

Star version. The subscript is given.

```
24 \def\diffstar{\@ifnextchar[{\@diffstar}{\@@diffstar}}
```

The ordre is given in square brakets, and there is a subscript.

```

25 \def\@diffstar[#1]#2#3#4{\mathchoice{\left(\frac{\dop^{#1}\difint#2}%
26 {\dop\difint#3^{#1}}\right)_{\mkern-7mu#4}}%
27 {\taille{\left(\frac{\dop^{#1}\difint#2}%
28 {\dop\difint#3^{#1}}\right)_{\mkern-7mu#4}}}%
29 {\scriptstyle{\left(\frac{\dop^{#1}\difint#2}%
30 {\dop\difint#3^{#1}}\right)_{\mkern-7mu#4}}}%
31 {\scriptstyle{\left(\frac{\dop^{#1}\difint#2}%
32 {\dop\difint#3^{#1}}\right)_{\mkern-7mu#4}}}}

```

There is only a subscript.

```

33 \def\@@diffstar#1#2#3{\mathchoice{\left(\frac{\dop\difint#1}%
34 {\dop\difint#2}\right)_{\mkern-7mu#3}}%
35 {\taille{\left(\frac{\dop\difint#1}{\dop\difint#2}%
36 \right)_{\mkern-7mu#3}}{\scriptstyle{\left(%
37 \frac{\dop\difint#1}{\dop\difint#2}\right)%
38 _{\mkern-7mu#3}}}%
39 {\scriptstyle{\left(\frac{\dop\difint#1}{\dop\difint#2}\right)%
40 _{\mkern-7mu#3}}}}

```

No star version (no subscript).

```
41 \def\diffnostar{\@ifnextchar[{\@diffnostar}{\@@diffnostar}}
```

The ordre is given in square brackets.

```

42 \def\@diffnostar[#1]#2#3{\mathchoice{\frac{\dop^{#1}\difint#2}%
43 {\dop\difint#3^{#1}}}%
44 {\taille{\frac{\dop^{#1}\difint#2}{\dop\difint#3^{#1}}}%
45 {\scriptstyle{\frac{\dop^{#1}\difint#2}{\dop\difint#3^{#1}}}}%
46 {\scriptstyle{\frac{\dop^{#1}\difint#2}{\dop\difint#3^{#1}}}}}

```

Basic notation.

```

47 \def\@@diffnostar#1#2{\mathchoice%
48 {\frac{\dop\difint#1}{\dop\difint#2}}%
49 {\taille{\frac{\dop\difint#1}{\dop\difint#2}}}%
50 {\scriptstyle{\frac{\dop\difint#1}{\dop\difint#2}}}%
51 {\scriptstyle{\frac{\dop\difint#1}{\dop\difint#2}}}}

```

## 4.2 Partial derivatives

Test of the star version.

```
52 \def\diffp{\@ifstar{\diffpstar}{\diffpnostar}}
```

Star version: a subscript is given.

```
53 \def\diffpstar{\@ifnextchar[{\@diffpstar}{\@@diffpstar}}
```

Ordre of derivative is given, and there is a subscript.

```

54 \def\@diffpstar[#1]#2#3#4{\mathchoice{\left(\frac{\partial^{#1}%
55 \derpint#2}{\partial\derpint#3^{#1}}\right)_{\mkern-7mu#4}}%
56 {\taille{\left(\frac{\partial^{#1}\derpint#2}{\partial\derpint#3^{#1}}%
57 \right)_{\mkern-7mu#4}}}%
58 {\scriptstyle{\left(\frac{\partial^{#1}\derpint#2}%
59 {\partial\derpint#3^{#1}}%
60 \right)_{\mkern-7mu#4}}}%
61 {\scriptstyle{\left(\frac{\partial^{#1}\derpint#2}%
62 {\partial\derpint#3^{#1}}%
63 \right)_{\mkern-7mu#4}}}}

```

There is only a subscript.

```

64 \def\@diffpstar#1#2#3{\mathchoice{\left(\{\begingroup
65 \toks0={}\count0=0
66 \degree #2\degree
67 \frac{\partial\ifnum\count0>1{\the\count0 }\fi\derpint#1}%
68 {\the\toks0}%
69 \endgroup\right)_{\mkern-7mu#3}}%
70 {\taille{\left(\{\begingroup
71 \toks0={}\count0=0
72 \degree #2\degree
73 \frac{\partial\ifnum\count0>1{\the\count0 }\fi\derpint#1}%
74 {\the\toks0}%
75 \endgroup\right)_{\mkern-7mu#3}}}%
76 {\scriptstyle{\left(\{\begingroup
77 \toks0={}\count0=0
78 \degree #2\degree
79 \frac{\partial\ifnum\count0>1{\the\count0 }\fi\derpint#1}%
80 {\the\toks0}%
81 \endgroup\right)_{\mkern-7mu#3}}}%
82 {\scriptstyle{\left(\{\begingroup
83 \toks0={}\count0=0
84 \degree #2\degree
85 \frac{\partial\ifnum\count0>1{\the\count0 }\fi\derpint#1}%
86 {\the\toks0}%
87 \endgroup\right)_{\mkern-7mu#3}}}}

```

No star version (no subscript is given).

```

88 \def\diffpnostar{\@ifnextchar[{\@diffpnostar}{\@diffpnostar}}

```

The ordre of derivative is given.

```

89 \def\@diffpnostar[#1]#2#3{\mathchoice{\frac{\partial^{#1}\derpint#2}%
90 {\partial\derpint#3^{#1}}}%
91 {\taille{\frac{\partial^{#1}\derpint#2}{\partial\derpint#3^{#1}}}%
92 {\scriptstyle{\frac{\partial^{#1}\derpint#2}{\partial\derpint#3^{#1}}}%
93 {\scriptstyle{\frac{\partial^{#1}\derpint#2}{\partial\derpint#3^{#1}}}}}

```

Basic notation.

```

94 \def\@diffpnostar#1#2{\mathchoice{\begingroup
95 \toks0={}\count0=0
96 \degree #2\degree
97 \frac{\partial\ifnum\count0>1{\the\count0 }\fi\derpint#1}%
98 {\the\toks0}%
99 \endgroup}%

```

```

100      {\taille{\begingroup
101      \toks0={}\count0=0
102      \degree #2\degree
103      \frac{\partial\ifnum\count0>1^{\the\count0 }\fi\derpint#1}%
104      {\the\toks0}%
105      \endgroup}}%
106      {\scriptstyle{\begingroup
107      \toks0={}\count0=0
108      \degree #2\degree
109      \frac{\partial\ifnum\count0>1^{\the\count0 }\fi\derpint#1}%
110      {\the\toks0}%
111      \endgroup}}%
112      {\scriptstyle{\begingroup
113      \toks0={}\count0=0
114      \degree #2\degree
115      \frac{\partial\ifnum\count0>1^{\the\count0 }\fi\derpint#1}%
116      {\the\toks0}%
117      \endgroup}}}

```

Macros used for crossed derivatives.

```

118 \def\degree #1{\ifx #1\degree \expandafter\stopd
119      \else \expandafter\addd \fi #1$#1\addd}
120 \def\stopd #1\addd{}
121 \def\addd #1^#2#3$#4\addd{\advance\count0 #2
122      \toks0=\expandafter{\the\toks0%
123      {\partial\derpint #4}%
124      \croisint}\degree}
125 \</package>

```