

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 syntax 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 $\frac{\partial^2 f}{\partial x^2}$ writing `\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: $\text{\diffp*}{f}{{x^2}{y^3}}{z}$ 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 `∂` 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 `∂x` and `∂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*{\ES@taille}[1]{\displaystyle{#1}}
5 \newcommand*{\ES@difint}{\mkern 0mu}
6 \newcommand*{\ES@derpint}{\mkern 0mu}
7 \newcommand*{\ES@croisint}{\mkern 0mu}
```

The `d` is roman by default..

```
8 \newcommand*{\ES@dop}{\mathrm{d}}
```

Options:

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

```

21 \DeclareOption{bigc}{\renewcommand*\ES@croisint{\ensuremath{:}}}
22 \ProcessOptions\relax

```

4.1 Derivative

Test of star version.

```

23 \newcommand*\diff[1]{\def\diff{\ifstar{\ES@diffstar}{\ES@diffnostar}}}
24 \def\diff{\ifstar{\ES@diffstar}{\ES@diffnostar}}

```

Star version. The subscript is given.

```

25 \def\ES@diffstar{\ifnextchar[\ES@diffstar@i]{\ES@diffstar@ii}}

```

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

```

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

```

There is only a subscript.

```

36 \def\ES@diffstar@ii#1#2#3{%
37 \mathchoice{\left(\frac{\ES@dop\ES@difint{#1}}{\ES@difint{#2}}\right)}%
38 {\ES@taille{\left(\frac{\ES@dop\ES@difint{#1}}{\ES@difint{#2}}\right)}}%
39 {\left(\frac{\ES@dop\ES@difint{#1}}{\ES@difint{#2}}\right)\mkern-7mu#3}%
40 {\right)\mkern-7mu#3}}{\scriptstyle\left(\frac{\ES@dop\ES@difint{#1}}{\ES@difint{#2}}\right)}%
41 {\frac{\ES@dop\ES@difint{#1}}{\ES@difint{#2}}}\right)\mkern-7mu#3}%
42 {\mkern-7mu#3}}%
43 {\scriptstyle\left(\frac{\ES@dop\ES@difint{#1}}{\ES@difint{#2}}\right)\mkern-7mu#3}%
44 {\mkern-7mu#3}}%

```

No star version (no subscript).

```

45 \def\ES@diffnostar{\ifnextchar[\ES@diffnostar@i]{\ES@diffnostar@ii}}

```

The ordre is given in square brackets.

```

46 \def\ES@diffnostar@i[#1]#2#3{\mathchoice{\frac{\ES@dop^{#1}}{\ES@difint^{#2}}}{%
47 {\ES@dop\ES@difint^{#3^{#1}}}}%
48 {\ES@taille{\frac{\ES@dop^{#1}}{\ES@difint^{#2}}}{\ES@dop\ES@difint^{#3^{#1}}}}%
49 {\scriptstyle\frac{\ES@dop^{#1}}{\ES@difint^{#2}}}{\ES@dop\ES@difint^{#3^{#1}}}}%
50 {\scriptstyle\frac{\ES@dop^{#1}}{\ES@difint^{#2}}}{\ES@dop\ES@difint^{#3^{#1}}}}%

```

Basic notation.

```

51 \def\ES@diffnostar@ii#1#2{\mathchoice{%
52 {\frac{\ES@dop\ES@difint{#1}}{\ES@difint{#2}}}}{%
53 {\ES@taille{\frac{\ES@dop\ES@difint{#1}}{\ES@difint{#2}}}{\ES@dop\ES@difint{#2}}}}{%
54 {\scriptstyle\frac{\ES@dop\ES@difint{#1}}{\ES@difint{#2}}}{\ES@dop\ES@difint{#2}}}}{%
55 {\scriptstyle\frac{\ES@dop\ES@difint{#1}}{\ES@difint{#2}}}{\ES@dop\ES@difint{#2}}}}%

```

4.2 Partial derivatives

Test of the star version.

```

56 \newcommand*\{\\diffp\}{}%
57 \def\\diffp{\@ifstar{\ES@diffpstar}{\ES@diffpnostar}}%
Star version: a subscript is given.
58 \def\\ES@diffpstar{\@ifnextchar[{\ES@diffpstar@i}{\ES@diffpstar@ii}}%
Ordre of derivative is given, and there is a subscript.
59 \def\\ES@diffpstar@i[#1]#2#3#4{%
60 \mathchoice{\left(\frac{\partial^{\#1}}{\partial \ER@derpint^{\#1}}\right)}{%
61 {\mkern-7mu#4}}{%
62 {\ES@taille{\left(\frac{\partial^{\#1}}{\partial \ES@derpint^{\#2}}\right)}{\mkern-7mu#4}}}{%
63 {\right)}{\mkern-7mu#4}}{%
64 {\scriptstyle{\left(\frac{\partial^{\#1}}{\partial \ES@derpint^{\#2}}\right)}}{%
65 {\partial^{\#1}}{\mkern-7mu#4}}{%
66 {\right)}{\mkern-7mu#4}}{%
67 {\scriptstyle{\left(\frac{\partial^{\#1}}{\partial \ES@derpint^{\#2}}\right)}}{%
68 {\partial^{\#1}}{\mkern-7mu#4}}{%
69 {\right)}{\mkern-7mu#4}}}}{%
There is only a subscript.
70 \def\\ES@diffpstar@ii[#1]#2#3{\mathchoice{\left(\{\begin{group}%
71 \toks0=\{}\count0=0%
72 \ES@degree #2\ES@degree%
73 \frac{\partial}{\partial \ifnum\count0>1{\the\count0}\fi\ES@derpint{\#1}}{%
74 {\the\toks0}}{%
75 \endgroup\right)}{\mkern-7mu#3}}{%
76 {\ES@taille{\left(\{\begin{group}%
77 \toks0=\{}\count0=0%
78 \ES@degree #2\ES@degree%
79 \frac{\partial}{\partial \ifnum\count0>1{\the\count0}\fi\ES@derpint{\#1}}{%
80 {\the\toks0}}{%
81 \endgroup\right)}{\mkern-7mu#3}}{%
82 {\scriptstyle{\left(\{\begin{group}%
83 \toks0=\{}\count0=0%
84 \ES@degree #2\ES@degree%
85 \frac{\partial}{\partial \ifnum\count0>1{\the\count0}\fi\ES@derpint{\#1}}{%
86 {\the\toks0}}{%
87 \endgroup\right)}{\mkern-7mu#3}}{%
88 {\scriptstyle{\left(\{\begin{group}%
89 \toks0=\{}\count0=0%
90 \ES@degree #2\ES@degree%
91 \frac{\partial}{\partial \ifnum\count0>1{\the\count0}\fi\ES@derpint{\#1}}{%
92 {\the\toks0}}{%
93 \endgroup\right)}{\mkern-7mu#3}}}}{%
No star version (no subscript is given).
94 \def\\ES@diffpnostar{\@ifnextchar[{\ES@diffpnostar@i}{\ES@diffpnostar@ii}}%
The ordre of derivative is given.
95 \def\\ES@diffpnostar@i[#1]#2#3{%
96 \mathchoice{\frac{\partial^{\#1}}{\partial \ES@derpint^{\#2}}}{%
97 {\partial^{\#1}}{\mkern-7mu#4}}{%
98 {\ES@taille{\frac{\partial^{\#1}}{\partial \ES@derpint^{\#2}}}{\mkern-7mu#4}}{%
99 {\scriptstyle{\frac{\partial^{\#1}}{\partial \ES@derpint^{\#2}}}}{%
100 {\scriptstyle{\frac{\partial^{\#1}}{\partial \ES@derpint^{\#2}}}}{\mkern-7mu#4}}}}{%

```

Basic notation.

```
101 \def\ES@diffpnostar@ii#1#2{\mathchoice{\begingroup
102     \toks0={}\count0=0
103     \ES@degree #2\ES@degree
104     \frac{\partial\ifnum\count0>1^{\the\count0 }\fi\ES@derpint#1}%
105     {\the\toks0}%
106     \endgroup}%
107     {\ES@taille{\begingroup
108         \toks0={}\count0=0
109         \ES@degree #2\ES@degree
110         \frac{\partial\ifnum\count0>1^{\the\count0 }\fi\ES@derpint#1}%
111         {\the\toks0}%
112         \endgroup}%
113         {\scriptstyle{\begingroup
114             \toks0={}\count0=0
115             \ES@degree #2\ES@degree
116             \frac{\partial\ifnum\count0>1^{\the\count0 }\fi\ES@derpint#1}%
117             {\the\toks0}%
118             \endgroup}%
119             {\scriptstyle{\begingroup
120                 \toks0={}\count0=0
121                 \ES@degree #2\ES@degree
122                 \frac{\partial\ifnum\count0>1^{\the\count0 }\fi\ES@derpint#1}%
123                 {\the\toks0}%
124                 \endgroup}}}}
```

Macros used for crossed derivatives.

```
125 \def\ES@degree #1{\ifx #1\ES@degree \expandafter\ES@stopd
126     \else \expandafter\ES@addd \fi #1^1$#1\ES@addd}
127 \def\ES@stopd #1\ES@addd{#1
128 \def\ES@addd #1^#2#3$#4\ES@addd{\advance\count0 #2
129     \toks0=\expandafter{\the\toks0%
130         {\partial\ES@derpint #4}%
131         \ES@croisint}\ES@degree}
132 
```