Mathematics

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Overview

Packages for systems of equations

Some packages very useful for mathematics are listed here below:

- *mathtools* which is mainly an upgrade of the very well-known "amsmath" package (the backbone for mathematics with LaTeX),
- *cases* which provides the `numcases` command to number all lines of a system of equations, and
- *systeme* which proposes tools to improve the display of the variables of the system.

Functions defined by domain

Tool: `cases` environment, `\\` before starting a new line, maximum one `&` per line. Must be included inside another mathematical equation environment.
For examples:

$$a = \begin{cases} x^2 + 2 & \text{if} x < 2 \\ \int x - 3 \, \mathrm{d}x & \text{if} x \geq 2 \end{cases} \tag{1}$$

$$a = \begin{cases} x^2 + 2 & \text{if } x < 2 \\ \int x - 3 \, \mathrm{d}x & \text{otherwise} \end{cases} \tag{2}$$

Extra: a starred version makes the right column *text-mode* instead of *math-mode*. A `dcases` variant makes the environment *displaystyle*. An `rcases` variant creates a closing bracket on the right side.

Systems of equations

One number for the whole system

Tool: `cases` environment (same as for defined-by-domain function).
Example:

$$\begin{cases} x + 2y - z = 1 \\ x - 3y + 2z = 4 \\ -x + y + z = 0 \end{cases} \tag{3}$$

Issues:

1. only one number the whole system but it would be useful to number each line of the system $\rightarrow$ see the *cases* package,
2. there is no alignment between the variables like it is sometimes done in algebra $\rightarrow$ see the *systeme* package.

Systems of equations

Numbering all lines of the system (1)

Tool: `numcases` environment from the *cases* package, \\ before starting a new line, maximum one & per line.
Examples:

$$\begin{cases} x + 2y - z = 1 & (4) \\ x - 3y + 2z = 4 & (5) \\ -x + y + z = 0 & (6) \end{cases}$$

$$a = \begin{cases} x^2 + 2 & \text{if } x < 2 \quad (7) \\ \int x - 3 \, \mathrm{d}x & \text{otherwise} \quad (8) \end{cases}$$

Extra: it corresponds to `dcases*` with all lines numbered, which means that:

- it is directly in *displaystyle*,
- the right column is in *text-mode*.

Systems of equations

Numbering all lines of the system (2)

Numbering style: `subnumcases` uses the same number and adds a letter in the equation tag.
Example:

$$\begin{cases} x + 2y - z = 1 & \text{(9a)} \\ x - 3y + 2z = 4 & \text{(9b)} \\ -x + y + z = 0 & \text{(9c)} \end{cases}$$

Systems of equations

Alignment on variables

Tool: `systeme` command from the *systeme* package, commas (,) used to separate equations. Works outside any math environment as well as inside `equation`.
Example:

$$\begin{cases} x + 2y - \ \ z = 1 \\ x - 3y + 2z = 4 \\ -x + \ \ y + \ \ z = 0 \end{cases} \tag{10}$$

Issue: the numbering counter used by the `systeme` command seems to not work properly the LaTeX's equation internal counter. Consequently, use it inside an `equation` environment.