Beautiful Mathematics Part 2

Me

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Contents

1 More Math Symbols

1.1 Sum

$\sum_{n=0}^{\infty} \frac{1}{n^2+1}$

$$\sum_{n=0}^{\infty} \frac{1}{n^2+1}$$

1.2 Integrals

$\int_0^{\infty} x^2 dx$
$\iint_D x^2 + y dy dx$

$$\int_0^{\infty} x^2 dx$$

1.3 Limits

$\lim_{x \to 1} x$

$$\lim_{x \to 1} x$$

1.4 Other

$\max_{n \in \{1,2,3\}} n$
$\min, \sup, \inf, \limsup$

$$\max_{n \in \{1,2,3\}} n$$

2 Exercise: Replicate the Mathematics 1

$$\sum_{n=1}^{\infty} \frac{1}{2^n} = 1$$

$$\iint_D e^{-x^2-y^2}\, dx\, dy$$

3 Mathematics on Multiple Lines

3.1 Multiline Equations

$$\begin{aligned} f(x) = 2x + 2x^2 + 2x + 2x^2 + 2x + 2x^2 + 2x + 2x^2 + 2x + \\ 2x^2 + 2x + 2x^2 + 2x + 2x^2 + 2x + 2x^2 + \\ 2x + 2x^2 + 2x + 2x^2 + 2x \\ + 2x^2 + 2x + 2x^2 + 2x + 2x^2 + 2x + 2x^2 \end{aligned} \tag{1}$$

3.2 Align env

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

In the (1) we can see how the equation is spanning Multiple lines.
In the (2) we can see how we can align 2 equations on a single line

3.3 Simplifying the equation with Align env

$$\begin{aligned} f(x) &= 2x + 3y - 2x \\ &= 3y \end{aligned}$$

4 Formatting Mathematics

Rule of thumb is that the inline Math in "$ $" env, should not exceed the $\frac{1}{3}$ of the text width. If it is longer than that we should be using a display Math in "\[\]" env.

We can also change the size of the parenthesees with "\big, \Big, \bigg, \Bigg" like this $\longrightarrow \Big(\Big(\bigg((.$

Also it is a good practice to leave a little space between the orgument of the "$\int$" and the "dx". So instead of $\int xdx$ we do "$\int x\,dx$" with "\," space (small space).

5 Exercise: Replicate the Mathematics 2

$$\begin{aligned}\int_0^1 \frac{(x+1)(x-2)}{x-3}\,dx &= \int_0^1 \frac{x^2-x-2}{x-3}\,dx \\ &= \int_0^1 x+2+\frac{4}{x-3}\,dx \\ &= \left[\frac{1}{2}x^2+2x+4\ln|x-3|\right]_0^1 \\ &= \frac{5}{2}+4\ln(2/3).\end{aligned}$$

6 Math Fonts

6.1 Boldface Math Font

$$a \to \mathbf{a}$$

6.2 Caligraphy fonts

$$T \to \mathcal{T}$$

6.3 Blackboard Boldface

$$R \to \mathbb{R}$$

6.4 Symbols

$$\bar{a}, \overline{ab}$$

$$\dot{f}, f', f''', f^{(3)}$$

7 Matrices and Cases

These envs need to be written inside of the math env (inline / display math, align, multiline or any other which accepts the math). It is not advised to write Matrices in inline math env.

7.1 Matrices

$$A = \begin{bmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \end{bmatrix}$$

7.2 Cases

$$|x| = \begin{cases} x & \text{for } x > 0 \\ 0 & \text{for } x = 0 \\ -x & \text{for } x < 0 \end{cases}$$

8 Exercise: Replicate the Mathematics 3

$$\mathbf{v} = \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix} \qquad A = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix}$$

9 Exercise: Replicate the Mathematics 4

$$f(x) = \begin{cases} 1, & \text{for } x > 0 \\ 0, & \text{for } x = 0 \\ -1, & \text{for } x < 0 \end{cases}$$

10 Making Theorems, Definitions, and Remarks

We have to create the Theorem env (in the preamble) with the "amsthm" package.

Theorem 10.1 (Name of theorem)**.** *This is a Theorem.*

Definition 10.2. *This is a definition.*

As we can see the theorem envs we created are all numbered. To change that we use "*" in the env definition (preamble).

Remark. *This is a remark.*

We can also label the theorem envs.
The definition: 10.2

11 Numbering and Theoremstyle

We can see that the definitions and theorems have their own individual counting (Section 10). We can change that with the option in preamble like so: "\newtheorem{definition}[theorem]{Definition}" where the "theorem" is the name of the env of which we want to continue the counting.

We can also include the number of the section when writing the theorem envs with the option "section" like this: "\newtheorem{theorem}{Theorem}[section]". We can also use options like "chapter" when we are writing a book, or "subsection" to include the number of the subsection as well as section.

We can also change the theorem style with the "\theoremstyle{}" and options: "plain" which is the default style, "definition" - the text is no longer italicised, "remark" - the text is italicised instead of being Boldface. These styles are applicable to all the "\newtheorem{}" underneath the new style.

With the theorem we also need *proof.*

Proof. This is a proof. □