Math 291: Lecture 3

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January 30, 2017

Outline

Display versus In-line Math

Compare the following:

- The fraction $\frac{3}{4}$
- The fraction
$$\frac{3}{4}$$
- The convergence of the infinite sum $\sum_{i=1}^{\infty} \frac{1}{n^p}$ is determined by the value of the parameter p.
- The convergence of the infinite sum
$$\sum_{i=1}^{\infty} \frac{1}{n^p}$$
is determined by the value of the parameter p.

Display versus In-line Math

- Notice that in each pair, there are differences in the size and subscript locations in the typeset formulae.
- LaTeX uses $\$ \cdots \$$ to typeset "in-line" equations.
- For displayed equations, there are a few options:
  - $\$\$ \cdots \$\$$
  - `\begin{displaymath},\end{displaymath}`
  - `\begin{equation},\end{equation}`
    (this command adds an equation number)
  - `\begin{equation*},\end{equation*}`
    (the * tells the compiler **not** to assign an equation number)
  - Antiquated Method: `\[, \]`

The Displaystyle Command

- Use of the `\displaystyle` command:
  - This command forces the size and format of a typeset formula to behave like a displayed equations while the equation itself remains in-line.
  - For example, compare these two:
    $\displaystyle\bigcap_{i=1}^{\infty} A_i$ (displaystyle) and $\bigcap_{i=1}^{\infty} A_i$ (regular in-line style).
- Changes to the size and subscript behavior occur in all "large symbols" such as: $\displaystyle\sum, \int, \bigcap, \bigcup, \bigvee$, etc.
- Changes to only subscript behavior occur in the commands: $\lim, \liminf, \min, \max$ etc.
  - For example consider: $\displaystyle\min_P L(P,f)$ and $\min_P L(P,f)$

Practice Exercises:

- Type $\displaystyle\lim_{n\to\infty} \frac{n^2}{3n^2 - 2n + 1} = \frac{1}{3}$ in four ways:
  - As an in-line equation (using $\$\cdots\$$)
  - As a displayed equation (using $\$\$\cdots\$\$$)
  - As a displayed equation with line numbers (using `\begin{equation}`,`\end{equation}`)
  - As an in-line equation (using using the `\displaystyle` command).

Outline

Sizing Grouping Symbols

- Compare the form of the statements: $(\frac{1}{2}+\frac{1}{5})$ and $\left(\frac{1}{2}+\frac{1}{5}\right)$.
- Sizable grouping symbols are added using the commands: `\left` and `\right`
- Possible arguments for these commands include: ( ) [] || ⌊⌋ etc.
- The compiler prefers for `\left` and `\right` arguments to be matched, and gives errors if they are not, but the command: "`\right.`" . can be used to match a left grouping symbol with an "empty" right grouping symbol (the corresponding command "`\left.`" creates an empty left grouping symbol).

Sizing of Grouping Symbols

- Practice:
  - Typeset the formula: $\left(1+\frac{1}{n}\right)^n \rightarrow e$.
  - Typeset the formula: $$\left[\frac{1}{x}+3x\right|_1^5=\frac{76}{5}-4=\frac{56}{5}$$
- Actual Code:
  - `$\left(1+\frac{1}{n}\right)^n \rightarrow e$`
  - `$$\left[\frac{1}{x}+3x\right|_1^5 =\frac{76}{5}-4=\frac{56}{5}$$`

Outline

Accents

- Here are some of the most frequently used accent characters:
  - $\hat{a}$, $\tilde{w}$, $\vec{x}$
  - These are typeset using: `\hat{a}`, `\tilde{w}`, `\vec{x}`
  - A few other common ones are: `\bar{}`, `\dot{}`, `\acute{}`,
  - Some special cases: we often use $\vec{\imath}$ and $\vec{\jmath}$ instead of $\vec{i}$ and $\vec{j}$
  - Use the special commands`\imath` and `\jmath` to get the un-dotted versions. (e.g. `\vec{\imath}`)
- Two more related symbols are `\widehat{}` and `\widetilde{}`
- For example, we used these instead of regular hats and tildes in these expressions: $\widehat{xyz}$ and $\widetilde{3xy}$

More Accents

- Three more common commands are: `\overline{}`, `\underline`, `\underbrace{}`.
- For example, consider: $\overline{\overline{a}^2 + \underline{xy} + \overline{\overline{z}}}$
- or: $(a+b)^2 = a^2 + \underbrace{ab + ab} + b^2 = a^2 + 2ab + b^2$
- If we include the package `amsmath`, we can also make use of additional commands like: `\overleftarrow{}`, `\underleftrightarrow{}`, `\xrightarrow[below]{above}` etc.
  - Recall: In LaTeX commands, [] indicates an optional argument, while { } indicates a required argument (empty is allowed).

Stacking Commands

There are several commands that allow us to place objects on top of one another.

- `\stackrel{upper}{lower}`
- `{upper \choose lower}`
- `{upper \atop lower}`
- For example, we can typeset: $\binom{n}{k} \stackrel{\text{def}}{=} \frac{n!}{k!\,(n-k)!}$
- Practice: Typeset $\underbrace{\overrightarrow{AB}+\overrightarrow{BC}}+\overrightarrow{CD} \xrightarrow[\text{addition}]{\text{vector}} \overrightarrow{AC}+\overrightarrow{CD} \stackrel{\text{simp}}{=} \overrightarrow{AD}$
- Here is the code to do this:

```
$$\underbrace{\overrightarrow{AB}+\overrightarrow{BC}}
+\overrightarrow{CD}
\xrightarrow[\mbox{addition}]{\mbox{vector}}
\overrightarrow{AC}+\overrightarrow{CD}
\stackrel{\mbox{\tiny simp}}{=} \overrightarrow{AD}$$
```

Outline

Long Equations

- The commands: eqnarray, eqnarray*, align, align* are all environments for typesetting multiple equations. The work as follows:
    - Each command compiles as if in math mode.
    - They are most often used for long derivations
    - They make use of the special alignment character &.
- “multline” and “split” are two special environments for a single long equation
- The “multline” command:
    - Compiles as if in math mode.
    - Allows line breaks to be added manually.
    - Equation numbers are placed either to the left of the first line or to the right of the last line.
    - Lines are justified as: left, center, . . . , center, right
- The “split” command:
    - Does not compile as if in math mode (so you can use it inside another environment such as equation or equation*).
    - Line breaks are still done manually.
    - Equation numbers are vertically centered (at least by default).
    - Lines are lined up with the use of the alignment character &.

Long Equations

- Practice: Type (with align or align*)

```
\begin{align}
\sin t  \left( \csc t - \sin t \right)
&= \sin t \left( \frac{1}{\sin t} - \sin t \right) \\
&= 1 - \sin^2 t \\
&= \cos^2 t
\end{align}
```

- Your output should look like:

$$\sin t \left(\csc t - \sin t \right) = \sin t \left(\frac{1}{\sin t} - \sin t \right) \tag{1}$$

$$= 1 - \sin^2 t \tag{2}$$

$$= \cos^2 t \tag{3}$$

- & indicates the location in each line that should act as the alignment reference, \\ says when to end a line.

Long Equations

- Next, try:

```
\begin{multline}
382x^{13}+32x^{12}+x^{11}+x^{10}+x^9+x^8+x^7+321x^6\\
+x^5+19x^4+x^3+38x^2+x+1
\end{multline}
```

- Your output should look like:

$$382x^{13} + 32x^{12} + x^{11} + x^{10} + x^9 + x^8 + x^7 + 321x^6 \\ + x^5 + 19x^4 + x^3 + 38x^2 + x + 1 \quad (4)$$

- Try this again using the commands `\begin{equation}\begin{split}`, etc.