Week 9

We have discussed producing data (using algorithms in Python) and analysing data (using Excel). We now need to discuss mathematical communication: how do we explain our results to other professionals in a clear, robust, unambiguous fashion.

Script

LaTeX

A mathematical calculation or argument needs to be *communicated*. Being able to do, or understand, the mathematics is not enough: you also need to be able to explain it to others.

A central tenet of communicating a mathematical argument is that each step must be clear and supported with evidence. The evidence can come from many sources: a previous equation or theorem, a section of text, a figure, or table, or external source. To make a mathematical argument a sequence of steps must be given and clearly linked so that the reader can follow each step and see how it is supported.

The purpose of LaTeX is to make it easier to produce a document containing a mathematical argument. In particular, it makes it easier to write equations and theorems, and to reference figures, tables and external sources. Its use is ubiquitous in scientific fields which use a lot of mathematics as it remains the best tool for making these sorts of arguments.

LaTeX can be used more broadly to produce Powerpoint-like presentations, CVs, letters, and so on. This is not necessarily recommended: choose the right tool for your purposes.

First steps

Using Overleaf or a local LaTeX editor:

- Open the `BasicLatex.tex` document.
- Compare the text between the `\begin{document}` and `\end{document}` to the `pdf` output.
- Look at whitespace.
- See how special commands start with a backslash
- See how *environments* form structures: the document, an itemized (or enumerated) list, equations, figures, and so on. These are indicated with the special `\begin{...}` and `\end{...}` commands.
- See how sections have their own special type of commands. Note the `\label` command after the section command. This produces no output, but is essential for cross-referencing as we will see.

Exercise

1. Modify the document by typing in some of your own text.
2. Add a new section, or subsection.

Cross-referencing

As we've said, we want to make a mathematical argument. We do this by adding equations, and references to previous steps in our document.

- Open the `BasicLatexBibtex.tex` document.
- Look at the labelled equation and the `\ref` command.

- Compare to the output.
- Look at the `\cite` command.
- Compare to the references at the end of the output.
- Compare to the content of the `references.bib` file.

Exercise

1. Add cross-references to other sections.
2. Add a new equation:

$$\lim_{n\to\infty} \frac{f(n)}{g(n)} = l \in (0, \infty).$$

   If you need to know the command for a LaTeX symbol, try the symbol finder.
3. Give your equation a label and cross-reference it.
4. Copy the citation below, add it to the `.bib` file, and cite it in the document.

```
@article{coniglio2018lot,
 title={Lot sizing with storage losses under demand uncertainty},
 author={Coniglio, Stefano and Koster, Arie MCA and Spiekermann, Nils},
 journal={Journal of Combinatorial Optimization},
 volume={36},
 number={3},
 pages={763--788},
 year={2018},
 publisher={Springer}
}
```