

# SM-2302: Software for Mathematicians

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## Module Description

Welcome to SM-2302! In many areas of mathematics, solutions to problems cannot be calculated explicitly and require the aid of computers. This module teaches students the programming skills required to solve such problems, namely in the area of differential equations, statistics, operational research, and other such areas of applied mathematics. Lectures will focus on teaching programming skills that are efficient and numerically stable, as well as how best to visualize problems. Students will appreciate the skills learned in this module when it comes to doing mathematical research during their final year projects and beyond.

## Module Contents

- Learning R and MATLAB languages for mathematical applications.
- R specific learning outcomes:
  - Logic and types
  - Data frames and matrices
  - Data wrangling using packages from the `{tidyverse}`
  - Visualisation using `{ggplot}`
- MATLAB specific learning outcomes:
  - Basic operations
  - Programming
  - Numerical techniques
  - Root finding
- Preparation of report-style documents using L<sup>A</sup>T<sub>E</sub>X.
- Version control and social coding using Git and GitHub.

## Readings

### *MATLAB*

- Peter Issa Kattan. *Matlab for Beginners: A gentle approach*. Petra books, 2008

## R

- Hadley Wickham. *Advanced R*. CRC press, 2019. URL: <https://adv-r.hadley.nz/>
- Hadley Wickham and Garrett Grolemund. *R for data science: import, tidy, transform, visualize, and model data*. O'Reilly Media, Inc., 2016. URL: <http://r4ds.had.co.nz/>

## Git and GitHub

- Tobias Günther. *Learn Version Control With Git: A Step-by-step Course for the Complete Beginner*. CreateSpace Independent Publishing Platform, 2017. ISBN: 9781548942465
- Ferdinando Santacroce. *Git Essentials: Create, merge, and distribute code with Git, the most powerful and flexible versioning system available*. Packt Publishing Ltd, 2017

## LaTeX

- Stefan Kottwitz. *LaTeX Beginner's Guide: Create visually appealing texts, articles, and books for business and science using LaTeX*. Packt Publishing Ltd, 2021
- <https://en.wikibooks.org/wiki/LaTeX>

## Class Format

See the end of the document for the full schedule

There are two timetabled slots that are for this module:

1. Tuesday 2.10pm–4.00pm
2. Friday 2.10pm–4.00pm

Unless otherwise specified, classes will be in-person at UTH, ICTC Lab 7. The Tuesday sessions will normally be reserved for lectures, while Friday sessions are lab-based tutorials. You are expected to attend both classes every week.

## Assessment

Take note that this module is wholly (100%) by coursework.

### Formative assessment

- Lab-based tutorials

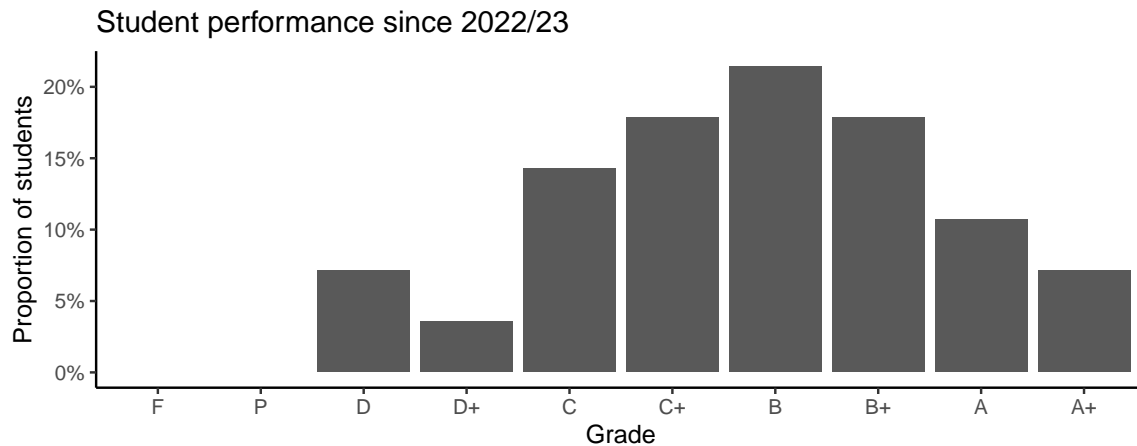
### Summative assessment

- **10% online quizzes:** 5% each on R and MATLAB topics.
- **5% discussion contribution:** On the topic of Git and GitHub.
- **20% individual assignments:** Two individual assignments (R and MATLAB) in the form of programming and/or debugging exercises.
- **30% group assignments:** Two group assignments (R and MATLAB). Here, students work together to solve a given problem. GitHub will be used so students can experience a collaborative development environment. Assignments will be peer-reviewed and discussed in class.
- **5% participation marks:** Completing two satisfactory peer reviews for the group assignments.

- **30% final project:** For this individual final project, students will work on an interesting topic in mathematics. Topics may be selected from a suggested list, or students may propose their own topics. The goal is to produce a short written report describing the (mathematical) problem, and how a solution is obtained using software.

## Key Data

- Past class sizes: 2022S1 = 28 (average: 28)
- SFE grade average: 4.4 / 5.0



## Class Schedule

Week	Topic	Instructor	Assessment
W01: 31/07 – 06/08	Introduction & Getting Started	HJ	
W02: 07/08 – 13/08	[R] Logic and types	HJ	
W03: 14/08 – 20/08	[R] Matrices and data frames	HJ	Quiz 1
W04: 21/08 – 27/08	[Git] Git and GitHub	HJ	Discussion 1
W05: 28/08 – 03/09	[R] The tidyverse	HJ	Individual 1
W06: 04/09 – 10/09	[R] Visualisations using ggplot	HJ	
W07: 11/09 – 17/09	[MATLAB] Basic operations	NHR	
18/09 – 24/09	Mid-semester Break		
W08: 25/09 – 01/10	[R] Peer review	HJ	Group 1
W09: 02/10 – 08/10	[MATLAB] Programming	NHR	
W10: 09/10 – 15/10	[MATLAB] Numerical techniques	NHR	Quiz 2
W11: 16/10 – 22/10	[MATLAB] Root-finding	NHR	Individual 2
W12: 23/10 – 29/10	[LaTeX] Typesetting reports	NHR	
W13: 30/10 – 05/11	[LaTeX] Beyond reports	NHR	
W14: 06/11 – 12/11	[MATLAB] Peer review / presentations	NHR	Group 2
13/11 – 19/11	Revision week		
20/11 – 26/11	Exam week		Final Report