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 the `R` language for mathematical applications.
- `R` specific learning outcomes:
  - Logic and types
  - Data frames and matrices
  - Data wrangling using packages from the `{tidyverse}`
  - Visualisation using `{ggplot}`
- Additional special topics in `R` (that helps with the group work):
  - Linear regression
  - Time series and predictive modelling
  - Geographic information system (GIS) in R
- Preparation of report-style documents using LaTeX and Quarto.
- Version control and social coding using Git and GitHub.

Readings

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

LaTeXand Quarto

- 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
- https://quarto.org/docs/get-started/hello/rstudio.html

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

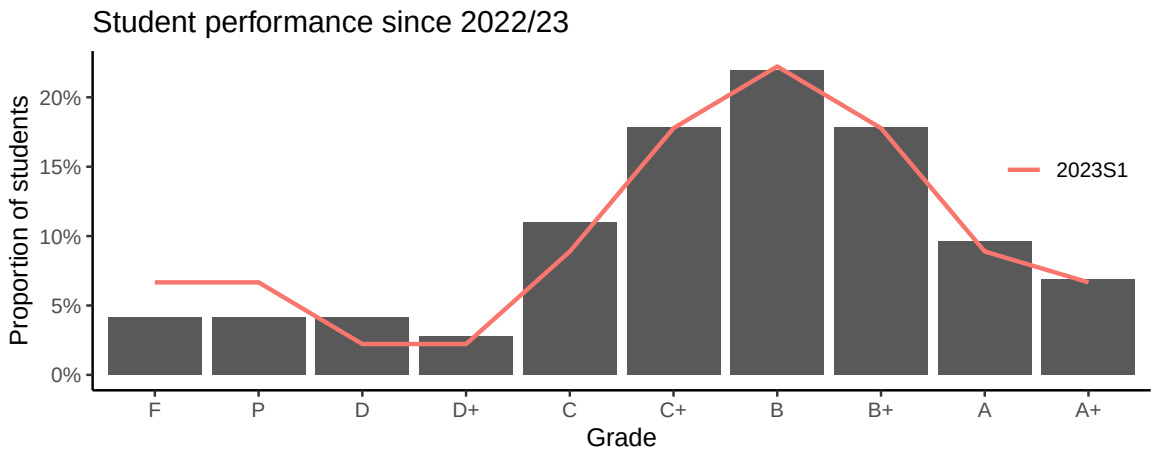
- Lab-based tutorials

Summative assessment

- **10% online quizzes**: 5% each on `R` topics.
- **5% discussion contribution**: On the topic of Git and GitHub.
- **25% class test**: An in-class assignment in the form of programming and/or debugging exercises.
- **60% group assignments**: This will be broken down into specific tasks
  - **10%** Individual contributions
  - **10%** Leadership role
  - **40%** Group report

Key Data

- Past class sizes: 2022S1 = 28, 2023S1 = 45 (average: 36.5)
- SFE grade average: 4.4 / 5.0



Class Schedule

Week	Topic	D1	D2	Assessment
W01: 29/07 – 04/08	Introduction & Getting Started	Lecture	Setup	
W02: 05/08 – 11/08	`[R]` Logic and types	Lecture	Tutorial	
W03: 12/08 – 18/08	`[R]` Matrices and data frames	Lecture	Tutorial	Quiz 1 (5%)
W04: 19/08 – 25/08	`[Git]` Git and GitHub	Lecture	Tutorial	Discussion (5%)
W05: 26/08 – 01/09	`[R]` The tidyverse	Lecture	Tutorial	
W06: 02/09 – 08/09	`[R]` Visualisations using ggplot	Lecture	Tutorial	Quiz 2 (5%)
W07: 09/09 – 15/09	Class test	Class test	No class	Class test (25%)
16/09 – 22/09	Mid-semester Break			
W08: 23/09 – 29/09	`[R]` Special topics 1	Lecture	Group check-in	
W09: 30/09 – 06/10	`[R]` Special topics 2	Lecture	Group check-in	
W10: 07/10 – 13/10	`[R]` Special topics 3	Lecture	Group check-in	
W11: 14/10 – 20/10	`[LaTeX]` Typesetting reports	Class 1	Class 2	
W12: 21/10 – 27/10	`[Quarto]` Reproducible research	Class 1	Class 2	
W13: 28/10 – 03/11	N/A	Group check-in	Group check-in	
W14: 04/11 – 10/11	N/A	N/A	N/A	
11/11 – 17/11	Revision week			
18/11 – 24/11	Exam week			Group Report (40%)