Data And Process Modelling (DSC 482.02) Syllabus

Fall Term 2023

Marcus Birkenkrahe

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Contents

1 General Course Information

- Meeting Times: Tuesday & Thursday, 14:30-15:45 hrs

- Meeting place: Derby Science Center computer lab 209

- Professor: Marcus Birkenkrahe

- Office: Derby Science Center room 210

- Phone: (870) 307-7254

- Office hours: MWF 10-10.30am, 2-4pm / TTH 9.30-11am, 12.15-2.15pm

2 Objectives

Models are abstractions that explain parts of the real world, e.g. to address, if not solve, complex problems like climate change, pandemics, or space exploration. Since the real world is only accessible to us through observation, observable data are key to building, verifying and using models. To support decision-making, data and processes are mined and modeled. In this course, we will explore model thinking and a wide array of data and process modeling tools. This special topic seminar is for everyone who is interested in using models and modeling languages to better understand the challenges and achievements of modeling.

Models can be explored mathematically and/or computationally via simulations in a computer. We will explore the use of R and/or Python to bring models froma variety of backgrounds to life, including: epidemiology, the physics of toilet paper, bungee jumping, and even Spider-Man.

Models can help us deal with the increasing complexity of our world, and understanding them will help us deal with many claims made by scientists and non-scientists about complex issues. Model literacy is an essential 21st century skill.

3 Student Learning Outcomes

Students who complete DSC 482.02 are able to:

- Understand data and process modeling challenges

- Use a variety of modeling languages to create models

- Make use of different modeling software environments

- Understand, and can present current modeling research

- Apply modeling tools to an area of their knowledge

- Present or write a scientific (IMRaD) essay on modern modeling methods

4 Course requirements

Formal prerequisites: MTH 101 (College Algebra), otherwise no prior knowledge required. Experience and knowledge of data or process modeling methods (e.g. Entity Relationship Diagrams, or Unified Modeling Language) is useful but not critical. Curiosity and active participations, especially during classroom presentations and discussion, is important. You will gain advanced data and process literacy skills by taking this course.

5 Grading

WHEN	DESCRIPTION	IMPACT
Weekly	Home assignment	25%
Weekly	Tests	25%
TBD	Sprint review presentations	25%
TBD	Final exam	25%

Notes:

- To pass: 60%

- There will be 15 home assignments in the form of interactive Python notebooks. Each assignment contributes 1.6667% (25/15) to your final grade. Late assignments are counted as 60% complete only.

- Sprint review presentations: a customer-focused single/team effort resulting in a project presentation, with 4 Scrum sprint reviews.

- Tests: weekly online quizzes, which are previewed and reviewed in class.

- Final exam: selection of the most challenging weekly quiz questions.

6   Dates and class schedule

Week	Date	Assignments	Project
1	Aug 21-Aug 25	Modeling with Python	
2	Aug 28-Sep 01	Bike share system	
3	Sep 04-Sep 08	Iterative modeling	
4	Sep 11-Sep 15	Parameters/metrics	1st sprint rev
5	Sep 18-Sep 22	Population models	
6	Sep 25-Sep 29	Iterating population models	
7	Oct 02-Oct 06	Limits to Growth	
8	Oct 09-Oct 13	Projecting into the future	2nd sprint rev
9	Oct 16-Oct 20	Analysis and computation	
10	Oct 23-Oct 27	Case studies part I	
11	Oct 30-Nov 03	Epidemiology/SIR models	
12	Nov 06-Nov 10	Quantifying interventions	3rd sprint rev
13	Nov 13-Nov 17	Sweeping parameters	
14	Nov 20-Nov 24	Nondimensionalization	
15	Nov 27-Dec 01	Thermal systems	
16	Dec 04-Dec 08	Modeling blood sugar	4th sprint rev

- NO CLASSES: Aug 21, Oct 10 (Fall break), Oct 19 (Service day), Nov 23 (Thanksgiving). See 2023-2024 academic calendar.

7   Textbooks (optional)

- You do not need to buy any books for this course.

- Some textbooks that I used to prepare this course:

  1. *Model Thinking: What You Need To Make Data Work For You*, by Scott E. Page, Basic Books, 2021. URL: umich.edu.

  2. *Modeling and Simulation in Python*, by Allen B. Downey, NoStarch Press, 2023. URL: greenteapress.com.

  3. *Exploring Modeling with Data and Differential Equations Using R*, by J.M. Zobitz, Version 3.0.0. URL: jmzobitz.github.io.

  4. *Modeling and Simulation in Python* by J.M. Kinser. CRC Press, 2022). URL: doi.org/10.1201/9781003226581.

  5. *Modeling Change and Uncertainty* by W.P. Fox and R.E. Burks. CRC Press, 2022. URL: doi.org/10.1201/9781003298762

6. *An introduction to mathematical modeling* by E.A. Bender, Wiley, 1978. Online: books.google.com.

8   Learning management system

- We use Lyon's Canvas installation for this course.

- The home page contains: assignments, grades, pages, people, syllabus, quizzes, Google Drive, Course evaluation and Zoom.

- The Zoom page includes cloud recordings of all past sessions.

- Recorded sessions will be deleted after the last class.

9   DataCamp (courses/workspace)

The course includes a free subscription to the DataCamp classroom at datacamp.com for further study, and for the opportunity to earn certificates. DataCamp is a popular data science online learning platform. DataCamp assignments are optional.

10   GitHub (course materials)

All course materials are available in a public GitHub repository (github.com/birkenkrahe/ai482). GitHub is the worldwide largest online platform for software development.

11   Lyon College Standard Policies (Fall 2023)

Online: `https://tinyurl.com/LyonPolicyF23`, see also Class Attendance