Statistical computation and analysis 2025-2
Course number: 367-1-4361

Lecturer: Opher Donchin
Tutorials: Hanna Kossowsky Lev

Communication with the instructors: by e-mail
Office hours: by appointment

Syllabus

An introduction to statistics for students with a strong engineering background. The course is based on a Bayesian statistical approach with a heavy emphasis on programming and algorithms, although it also covers frequentist methods in order to give students the ability to understand and apply them. It introduces the concepts of data, models, and inference. It discusses how data can be used to update models, emphasizing a modern Bayesian workflow, and how model comparison can be used to make inference. In covering Bayesian modeling, we cover algorithms including MCMC, HMC, and NUTS in some depth. In addition to basic Bayesian modeling, we show how the same methods can be used to construct more complex models including hierarchical models, regression models, ANOVA and GLMs. The course relies on Python and the PyMC package for sampling from Bayesian models and associated support packages including ArViz, Preliz, Bambi and PyTensor. Frequentist methods include maximum likelihood estimation, confidence intervals and hypothesis testing: t tests, F tests for anova and regression, chi squared tests, and the significance of the correlation coefficient.

Additional materials:

1) The course follows chapter 1-6 and 10 of the book: Martin Osvaldo A, *Bayesian Analysis with Python*. Packt Publishing. 2024. ISBN 978-1-80512-716-1

2) Lecture slides and recordings of previous lectures are available on the moodle site.

Course requirements:

- Exam: 70% (must pass the exam to pass the course). Open book in PC.
- In class mid-term quiz: 10% (can only improve grade)
- Pre-lecture quizzes: 5%
- Exercises: 15% (5 exercises each worth 3.6% with a possible 3 points of extra credit)

Important points: to pass the course you must pass the exam. Students who submit all 5 exercises can get up to 3 points of extra credit in the course (with a maximum course grade of 100).

Schedule

Lecture #	Date	Lecture	Book chapters	Date	Tirgul	Comments
				18.3		
1	19.3	Data and probability	Ch 1, 1-27	25.3		
2	26.3	Models and Bayesian updating	Ch 1, 28-44	1.4		**HW 1 handed out**
3	2.4	PyMC and sampling	Ch 2, 48-63	8.4		**HW 1 due** **HW 2 handed out**
4	9.4	Normal models	Ch 2, 64-87	*16.4*	*Passover*	
	15.4	*Passover*		22.4		
5	23.4	MCMC	Ch 10, 308-324, 327-338	29.4		**HW 2 due** **HW3 handed out**
	30.4	*Memorial day*		6.5	Mid-term	
6	7.5	Linear Models	Ch 4, 111-125, 133-136	13.5		

Lecture #	Date	Lecture	Book chapters	Date	Tirgul	Comments
7	14.5	Hierarchical Models	Ch 3, 91-102 Ch 4, 136-145	20.5		
8	21.5	Model comparison	Ch 5, 147-171	27.5		**HW3 due**
	28.5	*Student's day*	Ch 6, 186-198	3.6	Bambi	**HW4 due**
9	4.6	Categorical predicotors	Ch 6, 200-211	10.6		
10	11.6	Frequentist methods: basics		17.6		**HW4 due** **HW 5 handed out**
11	18.6	Frequentist methods: hypothesis tests		24.6		
12	25.6	Frequentist methods: advanced				
				1.7		**HW 5 due**