AGH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Module name: Advanced statistical modelling and data analysis

Academic year: 2019/2020 Code: ZSDA-3-0040-s ECTS credits: 3

Faculty of: Szkoła Doktorska AGH

Field of study: Szkoła Doktorska AGH Specialty: —

Study level: Third-cycle studies Form and type of study: Full-time studies

Lecture language: English Profile of education: Academic (A) Semester: 0

Course homepage: —

Responsible teacher: dr hab. inż. Baranowski Jerzy (jb@agh.edu.pl)

Module summary

The goal of the course is to familiarize PhD students with advanced computational models used in Bayesian statistics. The main focus is on Hamiltonian Monte Carlo methods and their implementation in Stan

Description of learning outcomes for module

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Connections with FLO	Method of learning outcomes verification (form of completion)
Social competence: is able to			
M_K001	Student knows how to critically asses and communicate scientific results.	SDA3A_K01	Activity during classes
Skills: he can			
M_U001	Student is able to critically analyze a scientific paper and present it contents to others with a special focus on statistical results.	SDA3A_U05, SDA3A_U01, SDA3A_U04	Activity during classes
Knowledge: he knows and understands			
M_W001	Student knows advanced methodologies of statistical modelling in the Bayesian paradigm	SDA3A_W03, SDA3A_W01	Activity during classes
M_W002	Student knows about Hamiltonian Monte Carlo methods and their difference from the classical MCMC.	SDA3A_W03, SDA3A_W01	Activity during classes

Number of hours for each form of classes

	Form of classes										
Suma	Lectures	Auditorium classes	Laboratory classes	Project classes	Conversation seminar	Seminar classes	Practical classes	Fieldwork classes	Workshops	Prace kontrolne i przejściowe	Lektorat
18	9	0	0	0	0	9	0	0	0	0	0

FLO matrix in relation to forms of classes

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Form of classes										
		Lectures	Auditorium classes	Laboratory classes	Project classes	Conversation seminar	Seminar classes	Practical classes	Fieldwork classes	Workshops	Prace kontrolne i przejściowe	Lektorat
Social competence: is able to												
M_K001	Student knows how to critically asses and communicate scientific results.	-	-	-	-	-	+	-	-	-	-	-
Skills: he can												
M_U001	Student is able to critically analyze a scientific paper and present it contents to others with a special focus on statistical results.	-	-	-	-	-	+	-	-	-	-	-
Knowledge: he knows and understands												
M_W001	Student knows advanced methodologies of statistical modelling in the Bayesian paradigm	+	-	-	-	-	+	-	-	-	-	-
M_W002	Student knows about Hamiltonian Monte Carlo methods and their difference from the classical MCMC.	-	-	-	-	-	-	-	-	-	-	-

Student workload (ECTS credits balance)

Student activity form	Student workload
Udział w zajęciach dydaktycznych/praktyka	18 h
Preparation for classes	18 h
Realization of independently performed tasks	18 h
Summary student workload	54 h
Module ECTS credits	3 ECTS

Additional information

Module content

Lectures

Main concepts of Bayesian data analysis

Monte Carlo Methods

Using Stan in data analysis

Seminar classes

Presentation and discussion of statistics applications
PhD Students are assigned research papers, which they study and present them to the gropup. Topics are dis

Teaching methods and techniques:

Lectures: The content of the lecture is presented in the form of a multimedia presentation in combination with a classic blackboard lecture enriched with shows related to the presented issues.
Seminar classes: Multimedia presentation and discussion

Warunki i sposób zaliczenia poszczególnych form zajęć, w tym zasady zaliczeń poprawkowych, a także warunki dopuszczenia do egzaminu:

Lectures – attendance
Seminars – the quality of presentation, and understanding and presentation of the concepts in the assigned papers.

Zasady udziału w poszczególnych zajęciach, ze wskazaniem, czy obecność studenta na zajęciach jest obowiązkowa:

Lectures:
– Attendance is mandatory: Yes
– Participation rules in classes: Students participate in classes learning the next teaching content according to the subject syllabus. Students should keep asking questions and clarifying doubts. Audiovisual registration of the lecture requires the teacher’s consent.
Seminar classes:
– Attendance is mandatory: Yes
– Participation rules in classes: Students participate in seminars and participate in discussion

Method of calculating the final grade

The grade will be established mostly on the discussion participation and the presentation of the assigned papers.

Sposób i tryb wyrównywania zaległości powstałych wskutek nieobecności studenta na zajęciach:

Individually determined with the lecturer based on length and reasons of absence.

Prerequisites and additional requirements

Basics of statistics, knowledge or either R or Python.

Recommended literature and teaching resources

1. Edwin Thompson Jaynes. Probability Theory: The Logic of Science. Cambridge University Press, (2003).
2. Devinderjit Sivia, John Skilling. Data Analysis: A Bayesian Tutorial. Oxford University Press; 2 edition, (2006)
3. Gelman, Carlin, Stern, Dunson, Vehtari & Rubin, Bayesian Data Analysis, 3rd ed, 2013
4. Richard McElreath (2016). Statistical Rethinking: A Bayesian Course with Examples in R and Stan CRC Press.
5. Michael Betancourt (2017), A Conceptual Introduction to Hamiltonian Monte Carlo, https://arxiv.org/abs/1701.02434
6. Betancourt, Michael; Byrne, Simon; Livingstone, Sam; Girolami, Mark. The geometric foundations of Hamiltonian Monte Carlo. Bernoulli 23 (2017), no. 4A, 2257—2298. doi:10.3150/16-BEJ810. https://projecteuclid.org/euclid.bj/1494316818
7. Stan https://mc-stan.org

Scientific publications of module course instructors related to the topic of the module

1. Bania, P., Baranowski, J.
Approximation of optimal filter for Ornstein–Uhlenbeck process with quantised discrete-time observation
(2018) International Journal of Control,
2. Baranowski, J., Bania, P., Prasad, I., Cong, T.
Bayesian fault detection and isolation using Field Kalman Filter
(2017) Eurasip Journal on Advances in Signal Processing,
3. Bania, P., Baranowski, J.
Bayesian estimator of a faulty state: Logarithmic odds approach
(2017) 2017 22nd International Conference on Methods and Models in Automation and Robotics, MMAR 2017,
4. Stief, A., Ottewill, J.R., Orkisz, M., Baranowski, J.
Two stage data fusion of acoustic, electric and vibration signals for diagnosing faults in induction motors
(2017) Elektronika ir Elektrotechnika,
5. Bania, P., Baranowski, J.
Field Kalman Filter and its approximation
(2016) 2016 IEEE 55th Conference on Decision and Control, CDC 2016,
6. Chilinski, J., Bauer, W., Baranowski, J.
Bayesian analysis of EEG signal frequency components
(2016) 2016 21st International Conference on Methods and Models in Automation and Robotics, MMAR 2016,

Additional information

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