

Interdisciplinary Programme

Academic Year 2017 - 2018

Big Data Analysis

MINT078 – Spring 2018 - 3 ECTS

Workshop, May 4 – 5 or May 18 – 19 (S1)

> PROFESSOR

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Course Description

This block course provides a basic introduction to big data and corresponding quantitative research methods. The objective of the course is to familiarize students with big data analysis as a tool for addressing substantive research questions. The course begins with a basic introduction to big data and discusses what the analysis of these data entails, as well as associated technical, conceptual and ethical challenges. Strength and limitations of big data research are discussed in depth using real-world examples. Students then engage in case study exercises in which small groups of students develop and present a big data concept for a specific real-world case. This includes practical exercises to familiarize students with the format of big data. It also provides a first hands-on experience in handling and analyzing large, complex data structures. The block course is designed as a primer for anyone interested in attaining a basic understanding of what big data analysis entails. There are no prerequisite requirements for this course.

Please note that the course is offered at two different dates, May 4/5 and May 18/19, and ensure that you are attending the session you are registered for.

Syllabus

Course Requirements

Requirement 1: Attendance in all parts of the workshop is required and students are expected to engage with the recommended readings and/or online resources in preparation for the course. It is essential that you come prepared and actively participate.

Requirement 2: Students will be required to complete case study exercises in small groups throughout the course. Evaluation will be based on (i) individual performance and participation throughout these exercises; (ii) a brief written case study report; and (iii) an oral presentation of results in the course. (ii) and (iii) are jointly prepared by each small case study group.

Course Evaluation

Performance in the course depends both on active participation and performance in the case study exercises. Evaluation will be based on:

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| 1. Active participation and contribution to the course | 20% |
| 2. Performance in case study exercises | 80% |

Course Material

The following are recommended for anyone interested in background readings on big data written for scientific and general audiences. Recommended scientific readings and/or online resources for individual sessions are provided with stable links in the course schedule below.

- Matthew J. Salganik. (2017). [Bit by Bit: Social Research in the Digital Age](#). Princeton University Press.
- Cathy O'Neil. (2016). [Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy](#). Penguin Books.
- Rob Kitchin. (2014). [The Data Revolution: Big Data, Open Data, Data Infrastructures and Their Consequences](#). SAGE Publications.

The first is book written for social scientists interested in conducting big data analysis and a useful guide for everybody interested in data science. The second book focuses primarily on possible downsides of algorithms and big data analysis in various domains. And the third book both provides an overview of big data, open data and data infrastructures and associated concepts as well as a discussion of potential shortcoming and (unintended) consequences of this paradigm shift for science and society.

Overview of the Course

The first day focuses on providing a theoretical and practical introduction to big data, its analysis and associated challenges. During the second day, students then apply this knowledge in an in-depth case study and prepare a case study report and oral presentation. The course provides a conceptual overview of technical aspects of big data analysis but there will be no practical exercises and no prior knowledge of programming is assumed.

Day 1: Fundamentals of Big Data Analysis

1. Introduction – What is Big Data?
2. Handling and Processing Big Data
3. Methodological Challenges and Problems
4. Example Applications

Day 2: Big Data Analysis in Practice

5. Case Study Session 1
6. Case Study Session 2
7. Preparation of Case Study Report and Presentation
8. Case Study Presentation

Course Schedule with Recommended Readings and Online Resources

Day 1: Fundamentals of Big Data Analysis

Session 1: Introduction – What is Big Data?

Friday, May 4 / May 18, 9:00-10:30

- Dutcher, Jenna. (2014). [What is Big Data?](#) *UC Berkeley Data Science Blog*.
- Press, Gil. (2014). [12 Big Data Definitions: What's Yours?](#) *Forbes Blog*.
- Manovich, Lev. (2012). [Trending: The Promises and the Challenges of Big Social Data](#). *Debates in the Digital Humanities*, edited by Matthew K. Gold. The University of Minnesota Press.
- Lazer, David, Alex Pentland, Lada Adamic, Sinan Aral, Albert-László Barabási, Devon Brewer, Nicholas Christakis, Noshir Contractor, James Fowler, Myron Gutmann, Tony Jebara, Gary King, Michael Macy, Deb Roy, and Marshall Van Alstyne. (2009). [Computational Social Science](#). *Science* 323(5915): 721-723.

Session 2: Handling and Processing Big Data

Friday, May 4 / May 18, 10:45-12:15

- Atz, Ulrich. (2013). [11 Tips on How to Handle Big Data in R](#). *Open Data Institute Blog*.
- Lockwood, Glenn. (2014). [Conceptual Overview of Map-Reduce and Hadoop](#). *Blog Post*.
- Jacobs, Bill. (2015). [Using Hadoop with R: It Depends](#). *Blog Post*.
- Penchikala, Srini. (2015). [Big Data Processing in Apache Spark – Part 1: Introduction](#). *InfoQ Article*.
- Venkataraman, Shivaram. (2015). [Announcing SparkR: R on Spark](#). *Databricks Blog Post*. ([R package](#))

Session 3: Methodological Challenges and Problems

Friday, May 4 / May 18, 14:00-15:30

- Bollier, David (2010). [The Promise and Peril of Big Data](#). *The Aspen Institute Communications and Society Program*.
- Cate, Fred H. (2014). [The Big Data Debate](#). *Science* 346(6211): 818-818.
- Lazer, David, Ryan Kennedy, Gary King, and Alessandro Vespignani. (2014). [The Parable of Google Flu: Traps in Big Data Analysis](#). *Science* 343(6176): 1203-1205.
- Lazer, David. (2015). [The Rise of the Social Algorithm](#). *Science* 348(6239): 1090-1091.
- Ulfelder, Jay. (2015). [The Myth of Comprehensive Data](#). *Blog Post*.

Session 4: Example Applications

Friday, May 4 / May 18, 15:45-17:15

- Viktoria Spaiser, Thomas Chadefaux, Karsten Donnay, Fabian Russmann, and Dirk Helbing. (2017). [Communication Power Struggles on Social Media: A Case Study of the 2011-12 Russian Protests](#). *Journal of Information Technology & Politics* 14(2): 132-153.
- Karsten Donnay. (2017). [Big Data for Monitoring Political Instability](#). *International Development Policy* 8.1 (Online).
- Pablo Barberá and Thomas Zeitzoff. (2017). [The New Public Address System: Why Do World Leaders Adopt Social Media?](#) *International Studies Quarterly* doi: 10.1093/isq/sqx047.

Day 2: Big Data Analysis in Practice

Session 5: Case Study Session 1

Saturday, May 5 / May 19, 9:00-10:30

Selection of case study topics and formation of small working groups. Students engage with the cases, read through background material provided in the session and work through an initial set of questions to deepen the understanding of the case. Sample applications and data is provided to help students familiarize themselves with the cases and available (big) data.

Session 6: Case Study Session 2

Saturday, May 5 / May 19, 10:45-12:15

Groups are given a specific task relevant to the case in question and are expected to develop a corresponding big data concept using the knowledge gained in the course and the parameters set by the case study scenario. A set of questions that help guide through the scenarios will be provided.

Session 7: Preparation of Case Study Report and Presentation

Saturday, May 5 / May 19, 14:00-15:30

Each group prepares a short 2 – 5 page report on their results and a 10 min oral presentation of their big data concept. There are no further requirements on the exact format of the report or the how the results are presented to the course (slides, flipchart etc.).

Session 8: Case Study Presentations

Friday, May 5 / May 19, 15:45-17:15

Presentation of big data concept to the group and discussion of results.