University of St.Gallen

Course and Examination Fact Sheet: Autumn Semester 2024

7,354: Data Analytics and Causal Inference

ECTS credits: 6

Overview examination/s

(binding regulations see below)
central - Written examination, Analog, Individual work individual grade (50%, 120 mins.)
Examination time: Lecture-free period
decentral - Written work, Digital, Group work group grade (50%)
Examination time: Term time

Attached courses

Timetable -- Language -- Lecturer
7,354,1.00 Data Analytics and Causal Inference -- English -- Eugster Beatrix
7,354,2.01 Data Analytics and Causal Inference: Exercises, Group 1 -- English -- Eugster Beatrix
7,354,2.02 Data Analytics and Causal Inference: Exercises, Group 2 -- English -- Eugster Beatrix

Course information

Course prerequisites

Students with no prior knowledge or experience in the methodology of empirical research in the social sciences may be required to familiarize themselves with some basic empirical methods. This can be done by studying relevant textbooks, such as Imai, Kosuke (2018) *Quantitative Social Science: An Introduction*. Princeton University Press. Note that the book covers topics beyond those discussed in this course. Refer to the course outline for the content of this course.

To hone their programming skills for data analysis, students are encouraged to attend the MIA mornings workshops 7,364 'Programming in R'; 7,366 'Data Handling and Manipulation' and 7,368 'Effective Data Visualization'.

Learning objectives

The course aims at imparting a basic understanding and intuition of quantitative research methods. The goal is to provide students of International Affairs with the foundation necessary to analyze data in their own research and to become critical consumers of statistical claims made in the news media, in policy reports, and in academic research. The following learning objectives should be attained after successful completion of both the lecture and the associated exercise sessions:

- Students have a strong working knowledge and the skills to identify and apply adequate methods in tackling problems in International Affairs.
- Students identify appropriate evidence and evaluate critically existing social science studies.
- Students systematically appraise theoretical and applied knowledge and understanding of quantitative research techniques.
- Students assess diverse theoretical and methodological approaches as they evaluate evidence in a systematic and critical manner.
- Students demonstrate proficiency in assessing the adequacy of statistical and causal inference methods to answer relevant research and policy questions in social sciences.

Course content

Substantive questions in empirical scientific and policy research are often causal. Does voter outreach increase turnout? Are job training programs effective? Can a universal health insurance program improve people's health? This course introduces students to both statistical theory and practice of causal inference, with a focus on applications in International Politics, Economics, Law, and Business Strategy.

The course puts special emphasis on an intuitive understanding of the relevant concepts, rather than the formal definitions and technicalities, which are kept to a necessary minimum. It has an applied focus: Students learn what methods can help them to answer particular research questions in their field, they learn how to make sense out of data, and to interpret and to critically assess existing data analyses. Examples adopting the different analysis methods and causal identification strategies are discussed to illustrate how the methods are used in practice.

In this course we use the open-source statistical software R (http://www.r-project.org). To help make using R easier, we'll be using RStudio (http://www.rstudio.com/), a user interface that simplifies many common operations.

The specific topics treated in this course are:

1. ***Data analytics*** (working with R, graphics, summary statistics, plots, implementation of statistical methods and model diagnostics)
2. ***Elementary notions of probability and statistics*** (random variables, expectation, variance, covariance, correlation, estimation, testing, confidence intervals, regression).
3. ***Causal inference*** (correlation vs. causation, experimental/observational data, potential outcome framework, counterfactuals, controls, matching, propensity scores, instrumental variables, difference-in-differences, regression discontinuity)

Course structure and indications of the learning and teaching design

The course consists of two components: (i) weekly lectures, in which the topics outlined in the section "course content" above are introduced, explained, illustrated, and discussed, and (ii) weekly exercise sessions, in which students present and discuss their solutions to weekly problem sets and further discussion on the content of the lecture part takes place. Participation in the exercise sessions should reflect solid preparation (students should have done the required readings for the week's topic, thought about the material, and done their best to understand it).

For the effective completion of the course, it is necessary to attend both the lecture sessions and the exercise group meetings.

Course literature

The course is based on the following textbooks (which also include topics not covered in the course) :

Rebecca Morten and Kenneth C. Williams (2012). *Experimental Political Science and the Study of Causality,* Cambridge University Press.

Joshua D. Angrist and Jörn-Steffen Pischke (2009) *Mostly Harmless Econometrics - An Empiricist's Companion*, Princeton University Press.

Scott Cunningham (2021). *Causal Inference - the Mixtape,* Yale University Press.

David A. Freedman (2010). *Statistical Models and Causal Inference - A Dialogue with the Social Sciences*, Cambridge University Press.

Guido W. Imbens and Donald B. Rubin (2015) *Causal Inference for Statistics, Social, and Biomedical Sciences: An Introduction*, Cambridge University Press.

Stephen L. Morgan and Christopher Winship (2014) *Counterfactuals and Causal Inference: Methods and Principles for Social Research*, Cambridge University Press.

Additional course information

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Examination information

Examination sub part/s

1. Examination sub part (1/2)

Examination modalities

Examination type	Written examination
Responsible for organisation	central
Examination form	Written exam
Examination mode	Analog
Time of examination	Lecture-free period
Examination execution	Synchronous
Examination location	On Campus
Grading type	Individual work individual grade
Weighting	50%
Duration	120 mins.

Examination languages

Question language: English
Answer language: English

Remark

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Examination-aid rule

Closed Book

The use of aids is prohibited as a matter of principle, with the exception of pocket calculator models of the Texas Instruments TI-30 series and, in case of non-language exams, bilingual dictionaries without any handwritten notes. Any other aids that are admissible must be explicitly listed by faculty members in the paragraph entitled “Supplementary aids” of the course and examination fact sheet; this list is exhaustive.

Procuring any aids, as well as ensuring their working order, is the exclusive responsibility of students.

Supplementary aids

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2. Examination sub part (2/2)

Examination modalities

Examination type	Written work
Responsible for organisation	decentral
Examination form	Written work
Examination mode	Digital
Time of examination	Term time
Examination execution	Asynchronous
Examination location	Off Campus
Grading type	Group work group grade
Weighting	50%
Duration	--

Examination languages

Question language: English
Answer language: English

Remark

Weekly problem sets, presented in the exercises.

Examination-aid rule
Free aids provision

Basically, students are free to choose aids. Any restrictions are defined by the faculty members in charge of the examination under supplementary aids.

Supplementary aids
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Examination content

Students are expected to make the following contributions:

- Problem sets (50%). There will be weekly problem sets. These problem sets provide an opportunity for students to conduct data analyses and to work on problems the solution of which will deepen their understanding of the concepts introduced in the lectures. In these weekly exercise classes, students give short presentations of their solutions to the problems, the quality of which serves as the basis of their evaluation in this part of the course.
- Central exam (50%). The exam assesses the understanding of the concepts introduced in this course (data analytics, elementary notions of probability and statistics, causal inference) and the ability to correctly interpret and criticize research results. Students should be able to interpret R code and output.

The specific topics are:

- 1. ***Data analytics*** (working with R, graphics, summary statistics, plots, implementation of statistical methods and model diagnostics)
  2. ***Elementary notions of probability and statistics*** (random variables, expectation, variance, covariance, correlation, estimation, testing, confidence intervals, regression).
  3. ***Causal inference*** (correlation vs. causation, experimental/observational data, potential outcome framework, counterfactuals, controls, matching, propensity scores, instrumental variables, difference-in-differences, regression discontinuity)

Examination relevant literature

Materials covered in the exam are provided through Canvas. All basic readings will be made available prior to the lectures. All exam relevant parts will be made available online prior to the last lecture.

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Please note

Please note that only this fact sheet and the examination schedule published at the time of bidding are binding and takes precedence over other information, such as information on StudyNet (Canvas), on lecturers' websites and information in lectures etc.
Any references and links to third-party content within the fact sheet are only of a supplementary, informative nature and lie outside the area of responsibility of the University of St.Gallen.

Documents and materials are only relevant for central examinations if they are available by the end of the lecture period (CW51) at the latest. In the case of centrally organised mid-term examinations, the documents and materials up to CW 43 are relevant for testing.

Binding nature of the fact sheets:

- Course information as well as examination date (organised centrally/decentrally) and form of examination: from bidding start in CW 34 (Thursday, 22nd August 2024);
- Examination information (supplementary aids, examination contents, examination literature) for decentralised examinations: in CW 42 (Monday, 14. October 2024);
- Examination information (supplementary aids, examination contents, examination literature) for centrally organised mid-term examinations: in CW 43 (Monday, 21 October 2024);
- Examination information (regulations on aids, examination contents, examination literature) for centrally organised examinations: two weeks before ending with de-registration period in CW 45 (Monday, 04 November 2024).