Remarks
Courses given on UNIL Campus.

Summary
This class provides a hands-on introduction to statistics and data science, with a focus on causal inference, applications to sustainability issues using Python, and dissemination of scientific results to a broad audience.

Content
• Exploratory Data Analysis: Data acquisition and cleaning; Descriptive Statistics; Data Visualization; Data Ethics, Bias, and Fairness
• Causal Inference: Linear Regression; Fixed effects; Non-linear Regression; Randomized Control Trial; Regression Discontinuity Design; Difference-in-Differences; Instrumental Variables
• Applications in Python to sustainability issues

Keywords
Data Science, Statistics, Econometrics, Causal Inference, Regression, Python, Sustainability, Scientific dissemination

Learning Prerequisites
Recommended courses
• Analysis
• Algebra
• Probability and statistics
• Econometrics
• Introduction to Python

Important concepts to start the course
• Basic probability and statistics knowledge (random variable, expectation, mean, conditional and joint distribution, independence, Bayes’ rule, central limit theorem)
• Basic linear algebra (matrix multiplication, system of linear equations)
• Multivariate calculus (derivative w.r.t. vector and matrix variables)
• Basic programming skills (labs will use Python, basic knowledge will help)

Learning Outcomes
By the end of the course, the student must be able to:
• Describe the main pitfalls behind data analysis
• Investigate dataset, and the problems and bias behind the data
• Explore and clean datasets
• Visualize datasets
• Decide which statistical/econometrics methods to use for a given problem
• Implement these methods in Python
• Estimate model parameters from empirical observations and confidence bounds
• Test hypothesis
• Synthesize their findings to a broad audience

Transversal skills
• Plan and carry out activities in a way which makes optimal use of available time and other resources.
• Demonstrate the capacity for critical thinking
• Use a work methodology appropriate to the task.
• Access and evaluate appropriate sources of information.

Teaching methods
• Lectures
• Exercise sessions: coding lab sessions
• Group projects

Expected student activities
The students are expected to:
• attend and actively participate in lectures and lab sessions
• work on the weekly theory and coding exercises
• collaborate on group projects making use of the theory learned during lectures and code developed during lab sessions (graded)

Assessment methods
The evaluation consists of one group project. Students will have to apply the data science and econometrics techniques learned during the class to causally answer a question related to sustainability. The grade is made of 2 deliverables:
• Mid-term project (20%): Students will have to submit a short deliverable to motivate their research question, present their exploratory data analysis, and discuss the potential issues they will face in their causal analysis;
• Final report (80%): Students will have to write a short article to present their work, targeting a broad audience.
Supervision

Office hours No
Assistants Yes
Forum No
Others Slack channel

Resources

Virtual desktop infrastructure (VDI)
No

Bibliography


Ressources en bibliothèque

• *Introduction to Computation and Programming Using Python / Guttag*
• *Mostly Harmless Econometrics / Angrist*
• *A Primer on Scientific Programming with Python / Langtangen*
• *Python Data Science Handbook / VanderPlas*

Notes/Handbook

Slides will be made available on a Moodle page. Notebooks will be made available in a GitHub repository.

Moodle Link

• https://go.epfl.ch/MGT-499

Prerequisite for

Data Science and Machine Learning (MGT-502)