UNIVERSITY OF MANNHEIM
School of Social Sciences

Quantitative Methods 2025:

Welcome to our course!

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About Us

About Us

Thomas Gschwend

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Substantive Research Interests

- Comparative Political Behavior
- Judicial Politics
- Electoral Systems

Methodological Expertise

- Statistical Modeling
- Experimental Design
- Simulations

About Us

Domantas Undzėnas

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Substantive Research Interests

- Political Psychology
- Causes of Prejudice
- Radical Right Politics

Methodological Expertise

- Machine Learning
- Experimental Design and Causal Inference
- Imputation Algorithms for Missing Data

About Us

Muhammad Muhammad

PhD Student, CDSS

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Substantive Research Interests

- Human Rights
- EU Politics
- Political Psychology

Methodological Expertise

- Causal Inference
- Spatial Data
- Data Visualization

About Us

David M. Grundmanns

PhD Student, CDSS

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Substantive Research Interests

- Judicial Politics
- Interest groups
- Comparative Political Institutions

Methodological Expertise

- Statistical Modeling
- Bayesian ideal point estimation (IRT)
- Quantitative Text Analysis

About You

About You

1. Learning is a collaborative exercise, therefore, we should all come together to help each other.
   - To help each other, collaborate and chat use the course Slack channel.
   - Support each other while collaboratively working on our weekly assignments.
2. If the way we handle things makes it hard for you to study effectively:
   - Talk to us about your concerns and let us know if/how we can help.

About This Course

Overview

Methods sequence in our political science graduate program:

- M.A.: Quantitative Methods (this class), required
- M.A.: Advanced Quantitative Methods (in spring), optional
- CDSS: Additional advanced classes focusing on specific techniques

Quantitative Methods: Overview

Goals and Objectives

- Passive
  - Understand logic of statistical inference
  - Recognize and understand basic linear models
  - Develop sound critical judgment of quantitative studies on political problems
  - Interpret quantitative analyses in published work
  - Be prepared for an advanced quantitative methods course (AQM) in spring
- Active
  - Use basic linear models to analyze political problems
  - Understand statistical results and interpret them correctly
  - Present results in an understandable way, preferably using effective visualizations
  - Use a powerful and free software to do all this: `R`

Quantitative Methods: Overview

Roadmap

- Understand and model stochastic processes
- Understand statistical inference
- Implement it mathematically and learn how to estimate it
  - OLS
  - Maximum Likelihood
- Implement it using statistical software
  - Learn how to use `R`
  - Basic programming skills

Format

- Quantitative Methods = Lecture + Lab
  - Lecture: "Quantitative Methods" (formerly "Multivariate Analyses")
  - Lab session: "Tutorial Quantitative Methods"
- The lecture introduces the methods and models, the labs apply them to data.
- You can then practice and deepen your understanding in the weekly homework assignments.

Expectations

- This is a time-intensive course with a high work load. Really!
- There are no prerequisites. We start from the beginning, but will cover substantial ground rather quickly; both in statistical theory and programming.
- Practice, practice, practice: Work together on weekly homework assignments, ask your instructors.
- Good news: Mastering quantitative methods is essential for the academic and non-academic job market.
- Even if you had a quantitative methods course during your undergraduate study, you will learn more advanced material here.

Grading

You will receive a grade for the lecture, and a pass/fail for the tutorial

- Weekly Homework Assignments: pass/fail
  - Short problems sets: Apply methods to data and gain proficiency with statistical software.
  - Homework for Weeks 1 and 2 must be completed individually. After that, you will work in groups of 2-3 students.
  - On each group submission, please indicate about how much each group member contributed towards it (in %).
  - Deadline: Thursdays, 23h59. Late submissions will not be accepted.
- Midterm Exam: 1/2
  - 90min exam on 29 October 2025 (same room, 8:30–10:00). No collaboration allowed.
  - We will provide sample questions beforehand.
- Data Analysis Essay: 1/2
  - Final paper (around 2,000 words). No collaboration allowed.
  - Application of statistical techniques to a substantive problem.
  - Deadline: 10 December 2025, 10h00. Late submissions will not be accepted.

Sessions

1. 3 September 2025: Introduction. Visualizing Data.
2. 10 September 2025: Fundamentals of Probability.
3. 17 September 2025: Sampling & Statistical Inference.
4. 24 September 2025: Linear Regression: Basics & Hypothesis Testing.
5. 1 October 2025: Linear Regression: Statistical Control & Causality.
6. 8 October 2025: Linear Regression: Dummies & Interactions.
7. 15 October 2025: Linear Regression: Interpreting Substantive Effects via the Simulation Method.
8. 22 October 2025: Linear Regression: Diagnostics.
9. 29 October 2025: Mid-Term Exam. No homework assignment due.
10. 5 November 2025: Non-linear Probability Models - The Likelihood Theory of Statistical Inference.
11. 12 November 2025: Binary Data.
12. 19 November 2025: Count Data.
13. 26 November 2025: Data Essay Q&A. Semester Wrap-Up.

Course Organization

Basics:

- Lecture
  - All lectures (starting from Sep 3) will be held in person.
- Lab Sessions
  - All labs (starting from Sep 4 and 5) will be held in person.
  - Register for one lab only and participate there regularly. Do not hop between labs.
- Office Hours
  - All office hours will be in person.

Learning R

Learning R

What is R?

- R is not only a statistical software package but also a statistical programming language.
- R is probably the most versatile statistical tool out there.
- It can do all the things other programs (like Stata, SPSS etc.) can do, but way more (and better).
- It is very flexible, and can also be used beyond traditional statistics, for example for webscraping, machine learning or deep learning.

Why R?

R is open-source.

- Developed from the commercial S language by two statisticians from New Zealand in the early 1990s.
- Today, the R development core team maintains "the engine".
- R has a vibrant community, that is still growing exponentially.
- Thousands of user/expert-generated, community-reviewed packages.
- Works very well together with other open-source programs like LaTeX.
- You get everything for free!

Learning R

- Learning R is like learning a new language.
  - Vocabulary (=commands)
  - Grammar (=structure of commands)
  - Practice, Practice, Practice!
- Very steep learning curve, may be overwhelming at first.
- Has its quirks you have to get used to.
- It will be hard work, and frustrating at times.
- We are here to help you to navigate around those cliffs.

Why R?

High investment means high returns

- Learning R will already pay off during your Master studies, in term papers and for your thesis.
- Used e.g. in
  - all fields of academia, from biology to economics
  - Wallstreet
  - NY Times data journalists [https://www.nytimes.com/2019/11/13/technology/personaltech/data-journalism-economics.html]
- Knowing R will not only help you in academia, but will pay off on the job market!
- At one point in your studies/academic work you probably have to learn it anyways. Do it now when you have the time and support!

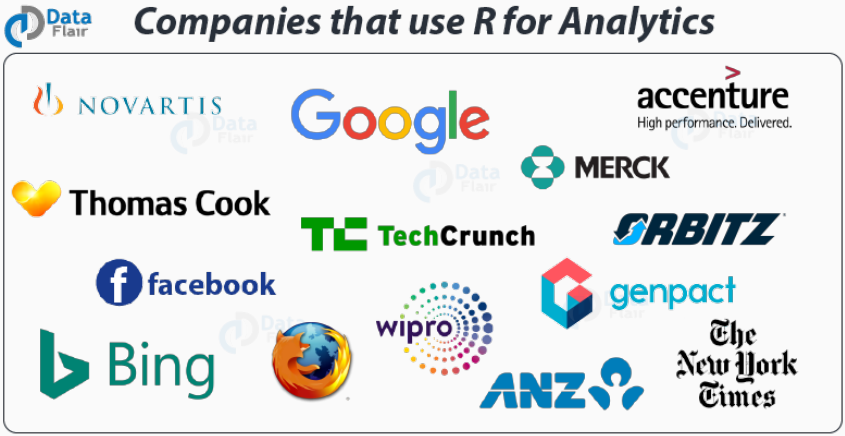

Figure 1: List of Companies that use R for Analytics

https://data-flair.training/blogs/r-applications/

R's Popularity

R is more than just a statistical software package.

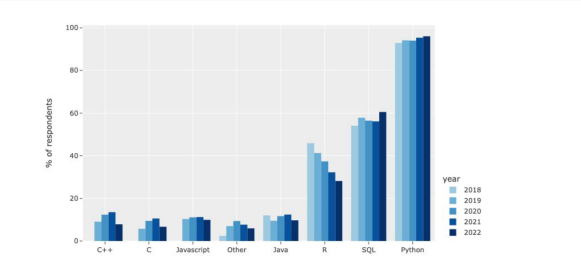

Figure 2: What tools are used at work? `https://www.kaggle.com/kaggle-survey-2022`

What Can You Do With R?

Figure 3: R Markdown for Academic Papers. http://svmiller.com/blog/2016/02/svm-r-markdown-manuscript/

What Can You Do With R?

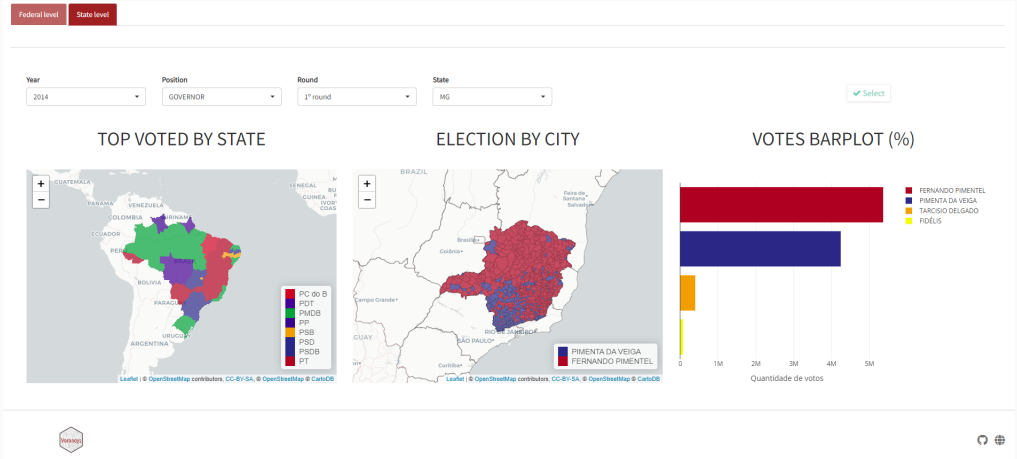

Figure 4: R Shiny App. https://voronoys.shinyapps.io/voronoys/?_ga=2.25271037.131103154.1662023781-1164504757.1658929037

What Can You Do With R?

Figure 5: Work by a former QM student.
`https://projekte.sueddeutsche.de/artikel/politik/europas-parteien-in-der-analyse-e894574` & `https://yannikbuhl.netlify.com`

The R Community

There is a **very active** R community online and not far from you offline that you can connect with.

- R-Ladies (local groups in Frankfurt and Cologne), `https://rladies.org/`
- Many local R user groups, `https://jumpingrivers.github.io/meetingsR/r-user-groups.html`
- R Community on Stack Overflow, `https://stackoverflow.blog/2017/10/10/impressive-growth-r/`
- #rstats hashtag on Twitter, `https://twitter.com/search?q=%23rstats&src=typed_query`

Our Support Infrastructure

Our Support Infrastructure

The learning curve... Looks frightening, but we will help you to get up there!

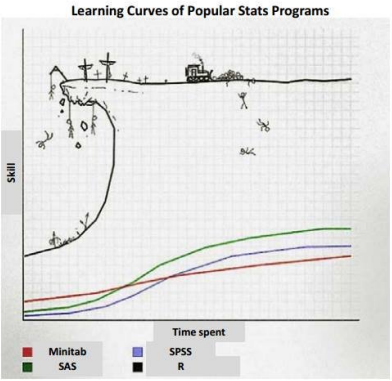

Figure 6: Source: Twitter/@rogierK

Our Support Infrastructure

You will all encounter challenges throughout the semester that you need help with. That's not a problem at all. Here is how you can get help:

- Talk to your fellow students. This class is a group effort. Helping each other is benefits everyone.
- Slack. We have created a Slack Workspace for this course. This fastest communication channel with us. Ask questions there if you encounter specific problems.
- Office hours. More in-depth support, especially for homework assignments.
  - Office hours are open to everyone and we are always happy to help.
  - If you want to attend our office hours, sign up by 17h00 on Monday through our homepage, with at least one specific question you want to have answered.
  - Given the number of people in the class, we might need to restrict the time we can offer for each student.
- Use the R community's online resources, use Stack Overflow, use Google. You will get better at this throughout the semester.

Our Support Infrastructure

ChatGPT for support?

- Yes, you are allowed to use ChatGPT (or other large language models)
- It can be extremely helpful
  - But not if you have no idea what you are doing
  - You need a good understanding of what you want to do (i.e., understand the lecture material)
  - And a good understanding of how R works
- Feel free to try out ChatGPT for coding but never let ChatGPT replace your own critical thinking and always understand the code you use
- **We suppose that all documents with your name on are written by yourself and are a product of your own critical thinking process.**

Our Support Infrastructure

We set up a homepage where you can find all the information and material that you need

- qm-uma.netlify.app

(Use the link on the syllabus on the access the homepage!)

Our Support Infrastructure

- Thomas Gschwend's email: `gschwend@uni-mannheim.de`
- Domantas Undzėnas's email: `domantas.undzenas@uni-mannheim.de`
- Muhammad Muhammad's email: `muhammad.muhammad@uni-mannheim.de`
- David Grundmanns's email: `david.grundmanns@uni-mannheim.de`

- Thomas Gschwend's office hours (Lecture): Tue, 13h30-14h30
- Domantas Undzėnas's office hours (Labs): Tue, 15h30-17h00
- Muhammad Muhammad's office hours (Labs): Tue, 15h30-17h00
- David Grundmanns's office hours : Wed, 15h30-17h00

Important things before you go

- The semester starts today:
  - The lectures start Wednesday (8:30) for everyone.
  - The lab sessions start this Thursday (8:30) and Friday (10:15) for everyone.
  - The first homework assignment will be distributed on Friday.
  - The deadline for the first homework assignment is next week Thursday.
- For all of these items you need your computer to be set-up! This includes:
  - Having installed R and RStudio.
  - Having installed git.
  - Having a GitHub account.
- If you haven't received the e-mail with our instructions, let us know after this session.
- It is no problem if you run into problems, but please contact us asap if you need support. We are happy to help!