

POLS0013: Measurement in Data Science

UCL Department of Political Science
School of Public Policy

Course Convenor: Dr. Julia de Romémont

Term 1 - Academic Year 25-26

Module Name:	Measurement in Data Science
Module Code:	POLS0013
Lecturer:	Dr Julia de Romémont (j.romemont@ucl.ac.uk)
Seminar leader:	Rob Davidson (rob.davidson.19@ucl.ac.uk)
Student Support & Feedback Hours:	TBD
Teaching:	• 10 x 2h lectures (Tuesdays, 9 – 11am) • 10 x 1h seminars (Tuesdays, 2pm, 3pm, 4pm)
Credits:	15
Assessment Method:	• In-class participation – 10% • 1500 word essay — 45% • 1500 word coursework – 45%
Assessment Deadlines:	• Essay: TBD • Coursework: TBD

Course Description

This module is designed for third year students in the undergraduate degrees in Philosophy, Politics and Economics, in Geography, in Population Health and in Social Sciences with the focus on [Social Data Science](#). It therefore assumes that you are familiar with the material in the required first and second year modules of those programmes. These preceding modules cover basic quantitative analysis, sampling, linear regression, regression models for binary and categorical outcomes (especially logistic regression), panel data and multi-level models. The module is now also open to third year students in the undergraduate degree in Politics and International Relations.

This module is fundamentally about the task of connecting the data that we use in quantitative analyses with the social science concepts that we are interested in making claims about. The processes of *conceptualisation* and *measurement* are sometimes used to distinguish between two parts of what we will be studying. In his

book “Conceptualization and Measurement in the Social Sciences”, Hubert Blalock writes “Conceptualization involves a series of processes by which theoretical constructs, ideas, and concepts are clarified, distinguished, and given definitions that make it possible to reach a reasonable degree of consensus and understanding of the theoretical ideas we are trying to express” (Blalock 1982, p.11)¹ “By measurement, we refer to the general process through which numbers are assigned to objects in such a fashion that it is also understood just what kinds of mathematical operations can legitimately be used, given the nature of the physical operations that have been used to justify or rationalize this assignment of numbers to objects.”

Measurement is important whether we are making causal claims or descriptive claims, at least if we want the evidence we collect to speak to underlying concepts of theoretical interest. It is common, but unfortunate, to have “slippage” between the analysis that researchers have done and how they talk about it. It is always tempting to report that you have shown something about a grand social scientific concept, conveniently forgetting that all you have actually done is demonstrated something about your dubious measure of that concept. One of the things that you learn in a module on causal inference is about a similar sort of slippage, whereby analyses that do not justify causal claims are discussed as if they do.

Note that the material of this module, similarly to causal inference modules, is that it does not always involve new estimation techniques. It often just involves careful thinking about which analyses to do, some of which may prove to be very simple. Some of the techniques covered in this module involve applying familiar regression analyses to data in a particular way so as to solve a measurement problem, much like several “causal inference methods” involve applying familiar regression analyses to data in a particular way (eg regression discontinuity designs and differences-in-differences). While some of the topics will involve new estimators and models, not all of them will. At several points in the module, we will define a problem, observe that if we had some types of data we could solve the measurement problem with a regression model, but that if we had different types of data, we would need a new method. As with causal inference, a lot of the core intellectual content here is figuring out what is possible and sensible with the data you have, not necessarily learning some fancier model that will magically make the limitations of the data go away.

Teaching Delivery

Lectures

Lectures will take place Tuesdays 9-11am. The lecture slides will be made available to you to download before the lecture on this website in the tab dedicated to the relevant week.

Seminars

This is a practical module, and a key learning objective is for students to be able to implement the statistical methods we cover during lectures to real data. Each week, you will complete a problem set which involves applying material from the course, writing code in the R programming language and interpreting the results. While these formative assessments do not count toward the final mark, they provide an opportunity for peer and instructor feedback. All assignments will be available on the course website the day of the relevant lecture, and annotated solutions will be released (also via the course website) a couple of days after the seminar.

The goal of these seminars is to provide you with ample time to ask questions about the problem set, and particular issues that relate to coding in R. During your allocated seminar time, you will be able

¹Blalock, Hubert M. 1982. Conceptualization and Measurement in the Social Sciences. 04; H61, B5

to ask questions of the teacher; speak with other students about the problem set; and watch short live demonstrations from your seminar teacher.

The one-hour seminars will take place in person on Tuesday afternoons. **Attendance during these seminar hours is mandatory and we will take a register at the beginning of the session.**

Please try to stick with your assigned seminar slot, such as to keep an even numbers distribution across the groups. If this is not possible, you can ask the Political Science undergraduate admin team (✉ polsci.ug@ucl.ac.uk) for help. *Note that the course convenor cannot help you with timetabling issues.*

Student Support and Feedback Hours

SSF hours are 1:1 meetings with the course convenor and are an occasion to ask questions about the course content and/or receive guidance on part I of the assessment (essay), among others.

More information about these will be provided towards the start of term.

Assessment

10% of the grade comes from in-class participation and is just pass-fail. To pass, students must have participated in **seven out of ten in-class quizzes**.

Students will write a 1500 word “essay” and submit a 1500 word “coursework”, each worth 45% of the grade. The essay involves finding and critiquing a pre-existing measure of a social science concept. The coursework involves completing a series of prompts that involve data analysis on a provided dataset, in the style of the weekly homework assignments.

- Assessment part I (“essay”) due end of term 1
- Assessment part II (“coursework”) due beginning of term 2

Please remember that plagiarism is taken extremely seriously and can disqualify you from the module (for details of what constitutes plagiarism see [here](#). If you are in doubt about any of this, ask the tutor.

Resources

- **Course website:** The main source of information for lecture recordings, lecture notes, quizzes, problem sets, and readings will be the course website, accessible [here](#).
- **Moodle page:** Other material relevant to the course, such as the lecture recordings and assessment (submission) formalities, will be accessible via the [course Moodle site](#)

Readings

This module combines a range of material that is not traditionally taught together (although it should be). As a result, Prof. Ben Lauderdale is in the process of writing a textbook for the module, *Pragmatic Social Measurement*, which provides most of the required readings for the module. The latest draft version of this book will be available via the course website.

You will find it useful to consult additional reference materials, and there are no shortage of possible references for most of the individual topics covered in the module. For each week in the schedule below, I list further readings on the theoretical ideas covered that week as well as applications of the resulting measurement techniques.

As a supplemental resource for several of the topics in the module, I highly recommend “An Introduction to Statistical Learning” (2nd Edition) by Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani. [The PDF of the textbook is freely available for download.](#) We will not cover all the topics in that book, because it aims to provide an introduction to “statistical learning” aka machine learning, and our aim in this module is to study measurement. Nonetheless, the topics in that book that are not covered in this module are well worth your time.

Software

Throughout the course we will use the free and open source statistical analysis software R.

Before the course starts, you can and should [download and install \(the latest version of\) R](#) on your personal computer. You should also also [download and install RStudio](#), which is a user-interface to R.

Please ensure that both R and RStudio are installed on your personal computers before the first lecture. This is recommended over using the UCL RStudio Server, which is only accessible online. UCL machines, either virtual via [Desktop@UCL](#) or on campus, will already have this software installed.

Academic Freedom and Intellectual Property

Academic freedom is the cornerstone of university research and teaching, so that all university staff, speakers, and students can freely explore questions and ideas and challenge perceived views and opinions, without being censored or harassed by a government, any state authorities, the University, other students, or external pressure groups. As part of the UCL academic community, all staff, speakers, and students share these responsibilities:

- **Everyone must respect freedom of thought and freedom of expression.** Your lecturer will not limit what can be discussed in the seminar, as long as it is relevant to the subject. They will not censor any topics, and they will expose you to controversial issues, questions, facts, views, and debates.
 - You may disagree with some facts or views that you read or hear in the classroom. You are encouraged to engage with these facts and views in a respectful manner.
 - Your lecturer will not penalise you merely for expressing views they or other students disagree with. However, they will expect you to present logical arguments supported by evidence.
- **You are explicitly prohibited from recording, publishing, distributing or transferring any class material/content**, in whole or in part, in any format, to any individual or entity outside the module, linking to or posting it online (including social media), or making it otherwise available to any person or entity outside the module, unless you have received prior specific written approval from the module leader. You are also explicitly prohibited from aiding or abetting in any of these actions. Similarly, your lecturer will not record, publish or distribute seminar sessions without the explicit consent of the participants.
- **By agreeing to take this module, you agree to abide by these terms.** If you do not comply with these terms, you will potentially be subject to disciplinary actions similar to those under violations of the university [Student Code of Conduct](#).

Schedule

The general schedule for the course is as follows. Details on topics covered and the readings for each week are provided on the following pages. Note that the order or focus of some of the topics may still be slightly altered ahead of the beginning of term.

Week 1 Measurement: What, Why and How

Week 2 Measurement Theory and Error

Week 3 Deriving Scales from Theory

Week 4 Supervised Scale Measurement I: Comparison Data

Week 5 Supervised Scale Measurement II: Regression

Week 6 Supervised Scale Measurement III: Linear Indices

Week 7 Supervised Class Measurement

Week 8 Unsupervised Scale Measurement I: Interval-Level Indicators

Week 9 Unsupervised Scale Measurement II: Categorical Indicators

Week 10 Unsupervised Class Measurement

Syllabus

Week 1 Measurement: What, Why and How

Topics: What *is* measurement? Why is measurement important? Representative versus pragmatic measurement. How are social measurements used and misused?

Required reading:

- Chapters 1 & 2, *Pragmatic Social Measurement*

Further reading:

- David J Hand. “Measurement : a very short introduction”. Oxford University Press 2016.
 - Ethan Bueno de Mesquita, “The Aims of Public Policy Address: The Perils of Quantification”
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Week 2 Measurement Theory and Error

Topics: Definition of measurement error. What does it mean for measurements to be fair or unfair? Measurements as functions of indicators. Consequences of measurement error for subsequent analyses.

Required reading:

- Chapters 3, 4 & 5, *Pragmatic Social Measurement*

Further reading:

Applications - Political Science

- Asher, Herbert B. “Some consequences of measurement error in survey data.” *American Journal of Political Science* (1974): 469-485.
- Achen, Christopher H. “Proxy variables and incorrect signs on regression coefficients.” *Political Methodology* (1985): 299-316.
- Bartels, Larry M. “Messages received: The political impact of media exposure.” *American political science review* 87.2 (1993): 267-285.

Applications - Health

- Butler, Joseph S., et al. “Measurement error in self-reported health variables.” *The Review of Economics and Statistics* (1987): 644-650.
- Alan B. Krueger and David A. Schkade. “The Reliability of Subjective Well-Being Measures” *Journal of Public Economics* 2008 Aug; 92(8-9): 1833–1845.

Further Theory

- Pischke, Steve. “Lecture Notes on Measurement Error”
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Week 3 Deriving Scales from Theory

Topics: Using theoretical arguments to derive measures from indicator data. Axiomatic Analysis. Dimensional Analysis

Required reading:

- Chapter 6, *Pragmatic Social Measurement*

Further reading:

Applications

- Foster, James and Greer, Joel and Thorbecke, Erik “A class of decomposable poverty measures” *Econometrica* (1984): 761-766
- Laakso, Markku and Rein Taagepera. “Effective Number of Parties: A Measure with Application to West Europe” *Comparative Political Studies* (1979):3-27
- Rein Taagepera, Bernard Grofman. “Mapping the Indices of Seats–Votes Disproportionality and Inter-Election Volatility” *Party Politics* (2003)

Misc

- An introductory algebra level YouTube video [Intro to Dimensional Analysis](#)
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Week 4 Supervised Scale Measurement I: Comparison Data

Topics: Scoring competition data. Rating transfer systems. Bradley-Terry models. Interpretation of latent variable models.

Required reading:

- Chapter 7, *Pragmatic Social Measurement*

Further reading:

Bradley-Terry Models

- Heather Turner and David Firth. “Bradley-Terry Models in R: The BradleyTerry2 Package”

Applications - Political Science

- Peter John Loewen, Daniel Rubenson and Arthur Spirling. “Testing the power of arguments in referendums: A Bradley–Terry approach” *Electoral Studies*. Volume 31, Issue 1, March 2012, Pages 212-221
- Zucco Jr, Cesar and Batista, Mariana and Power, Timothy J. “Measuring portfolio salience using the Bradley–Terry model: An illustration with data from Brazil” *Research & Politics* 2019 6:1.

Applications - Health/Medicine

- J. N. S. Matthews and K. P. Morris. “An Application of Bradley-Terry-Type Models to the Measurement of Pain” 1995.

Applications - Geography

- P. A. Longley and N. Wrigley. “Scaling Residential Preferences: A Methodological Note” *Journal of Economic and Social Geography*. 1984.
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Week 5 Supervised Scale Measurement II: Regression

Topics: Strategies for scale development with training data. Predictive modelling as measurement. Scales as linear functions of indicators. Estimating weights using training / “gold standard” data.

Required reading:

- Chapter 8, *Pragmatic Social Measurement*

Further reading:

Theory

- James et al 2023. *An Introduction to Statistical Learning*, 2nd Edition, Springer Ch 2-3

Applications

- Where-to-be-born Index (The Economist Intelligence Unit)
 - Pew Research Center, “Can Likely Voter Models Be Improved?? 2. Measuring the likelihood to vote”
 - Pourghasemi, H.R., Moradi, H.R. & Fatemi Aghda, S.M. Landslide susceptibility mapping by binary logistic regression, analytical hierarchy process, and statistical index models and assessment of their performances. *Nat Hazards* 69, 749–779 (2013).
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Week 6 Supervised Scale Measurement III: Linear Indices

Topics: Strategies for scale development without training data. Developing weights using qualitative expertise.

Required reading:

- Chapter 9, *Pragmatic Social Measurement*

Further reading:

Theory

- Gerardo Munck and Jay Verkuilen. “Conceptualizing and Measuring Democracy: Evaluating Alternative Indices” *Comparative Political Studies* 2002.
- Krista Loose, Yue Hou and Adam Berinsky. “Achieving Efficiency Without Losing Accuracy: Strategies for Scale Reduction with an Application to Risk Attitudes and Racial Resentment”

Country-Level Indices

- Fragile States Index (Fund for Peace)
- Global Liveability Index (The Economist Intelligence Unit)
- Human Capital Index (World Bank)

- World Press Freedom Index (Reporters without Borders)
- Global Gender Gap Index (World Economic Forum)
- Euro Health Consumer Index (Health Consumer Powerhouse Ltd)
- Democracy Index (The Economist Intelligence Unit)
- Freedom House Indices (Freedom House)
- Polity Scores (Polity Project)
- Global Terrorism Index (Institute for Economics and Peace)
- Global Peace Index (Institute for Economics and Peace)
- Global Health Security Index (Nuclear Threat Initiative, Johns Hopkins Center for Health Security & the Economist Intelligence Unit)
- Corruption Perception Index (Transparency International)
- Index of Economic Freedom (Heritage Foundation)

Sub-National Area-Level Indices

- Index of Multiple Deprivation (UK)
- Child Well-being Index (UK)

Individual-Level Indices

- Beck Anxiety Inventory
- PHQ-9 (Depression)

Week 7 Supervised Class Measurement

Topics: Assessing whether a target concept should be treated as continuous or categorical. Supervised classification (coding, training).

Required reading:

- Chapter 10, *Pragmatic Social Measurement*

Further reading:

Theory

- James et al 2023, Ch 4
- Collier, David, Jody LaPorte, and Jason Seawright. “Putting typologies to work: Concept formation, measurement, and analytic rigor.” *Political Research Quarterly* 65.1 (2012): 217-232.

Applications

- Anna Luhrmann, Marcus Tannenberg and Staffan I. Lindberg. “Regimes of the World (RoW): Opening New Avenues for the Comparative Study of Political Regimes”
 - Rooduijn et al. “The PopuList” A populism classification of European parties from 31 countries.
 - Kostas Gemenis. “What to Do (and Not to Do) with the Comparative Manifestos Project Data”
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Week 8 Unsupervised Scale Measurement I: Interval-Level Indicators

Topics: Learning scale weights from sample covariation. Principle Components Analysis (PCA). Exploratory Factor Analysis (EFA).

Required reading:

- Chapter 11, *Pragmatic Social Measurement*

Further reading:

Theory

- [James et al 2023, Ch 12-12.2](#)
- Everitt, Brian, and Torsten Hothorn. 2011. An Introduction to Applied Multivariate Analysis with T. SpringerScience & Business Media., Ch 3 & 5
- Bartholomew, David J, et al. 2008. Analysis of Multivariate Social Science Data. Chapman; Hall/CRC., Ch 5 & 7

Applications

- [Whitmore, Andrew. "A statistical analysis of the construction of the United Nations E-Government Development Index" Government Information Quarterly Volume 29, Issue 1, January 2012, Pages 68-75](#)
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Week 9 Unsupervised Scale Measurement II: Categorical Indicators

Topics: Item response theory for data with binary and/or ordinal indicators.

Required reading:

- Chapter 12, *Pragmatic Social Measurement*

Further reading:

Theory

- Bartholomew, et al. 2008, Ch 8 & 9

Applications

- [Shawn Treier and Simon Jackman, "Democracy as a Latent Variable" American Journal of Political Science. Volume 52, Issue 1. January 2008. Pages 201-217](#)
 - [Shawn Treier, D. Sunshine Hillygus, "The Nature of Political Ideology in the Contemporary Electorate", Public Opinion Quarterly, Volume 73, Issue 4, Winter 2009, Pages 679-703](#)
 - [Treier, S. \(2010\). Where Does the President Stand? Measuring Presidential Ideology. Political Analysis, 18\(1\), 124-136.](#)
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Week 10 Unsupervised Class Measurement

Topics: Unsupervised classification (clustering, latent class analysis).

Required reading:

- Chapter 13, *Pragmatic Social Measurement*

Further reading:

Theory

- Bartholomew, et al. 2008, Ch 2 & 10
- Everitt & Hothorn. 2011., Ch 6
- [James et al 2023, Ch 12.4](#)
- Linzer & Lewis, “poLCA: An R Package for Polytomous Variable Latent Class Analysis”, *Journal of Statistical Software*, 42:10, 2011.
- Justin Grimmer and Gary King. “General purpose computer-assisted clustering and conceptualization” *PNAS* February 15, 2011 108 (7) 2643-2650
- John S Ahlquist and Christian Breunig. “Model-based Clustering and Typologies in the Social Sciences