

Quantitative Tools – Applied Econometrics

Course Announcement

M.Sc. Business Administration

Prof. Dr. A. Tarassow

Brandenburg Applied University of Sciences

As of: October 2024

Course Information

- **Lecture:** 2 hours per week
- **Exercise:** 2 hours per week
- **Credit Points:** 6 ECTS for 4 hours per week
- **Attendance Time:** 60 hours (Lectures, Computer-based processing of case studies)
- **Self-Study:** 90 hours
- **Final Examination:** Written exam

Course Instructor

Prof. Dr. A. Tarassow

Magdeburger Straße 50, A.3.0.4 (WWZ)

tarassow@th-brandenburg.de

Office hours: by appointment.

Course Overview

The module is designed for first-year master's students in business administration who are interested in applying economic concepts to empirical contexts. The course focuses both on the theory of fundamental methods and on practical implementation using software.

1 Learning Objectives

Empirical economic research is unthinkable without econometrics and is therefore a prerequisite for common master's programs in economics and social sciences. The course deals with the modelling and estimation of regression and classification models. After the course, students will be able to check data for completeness, visualize it, and describe it using descriptive statistics. Students can conduct, evaluate, and interpret regression analyses as well as perform hypothesis tests. Basic tests for equality of trend are also familiar to the students. Students will be able to specify, estimate, and interpret binary classification models. Lastly, students will learn techniques for dimension reduction and methods from machine learning to identify clusters. The lecture will be supplemented by computer exercises using the open-source and freely available software package Gretl.

2 Methodology

The course is designed as a lecture with an accompanying exercise (a total of 4 hours per week), with the exercises taking place in the computer lab. Exercise materials and datasets will be provided.

3 Course Prerequisites

- Successful completion of an introductory course in econometrics, e.g., the course "Applied Econometrics".
- Applicable (basic) knowledge in mathematics and statistics or the willingness to acquire this knowledge.
- General willingness to acquire knowledge in the Gretl software and to conduct practical exercises with it.

Topics

1. Introduction to Econometrics

Literature:

- (a) [Von Auer \(2023\)](#), Kap. 1.1-1.3
- (b) [Verbeek \(2017\)](#), Ch. 1.1

2. Introduction to Data and Data Types

Literature:

- (a) [TBA](#)

3. Descriptive Statistics

Literature:

- (a) Cramer and Kamps (2020, Ch. A1, A2, A3, A4, A7), <https://link.springer.com/book/10.1007/978-3-662-60552-3>
- (b) Yu and Barter (2024, Ch. 5.2), https://vdsbook.com/05-data_viz#sec-numeric-explorations
- (c) Von Auer (2023, 2.2, 2.4)

4. Regression Methods and least squares estimator

- (a) Derivation of the OLS Estimator
- (b) Interpretation of Coefficients
- (c) Goodness-of-Fit Measures
- (d) Literature:

- i. Verbeek (2017, Ch. 2, 3.1, 3.2.1, 3.3.1, 3.3.2, 4.1, 4.3-4.5)
- ii. James et al. (2023, Ch. 3.1-3.4), https://hastie.su.domains/ISLP/ISLP_website.pdf.download.html
- iii. Malitte and Schreiber (2019, Kap. 4.1-4.3), <https://link.springer.com/book/10.1007/978-3-662-58275-6>
- iv. Adkins (2018, Ch. 2.1-2.5, 2.7, 3.1-3.6, 4.4, 4.7, 4.9, 5.1-5.4, 6.1)

5. Gauss-Markov conditions and tests in model specification

- (a) Concepts of Unbiasedness and Efficiency
- (b) Specification Tests: Heteroskedasticity, Functional Form
- (c) Literature: Winker (2017, Kap. 8.1-8.3), Malitte and Schreiber (2019, Kap. 4.2.8-4.2.9, 5.1-5.2), Von Auer (2023, Kap. 4.1-4.3), Adkins (2018, Kap. 6.3-6.4)

6. Inference and hypothesis testing

- (a) Interval estimator
- (b) t-Test
- (c) F-Test
- (d) Literature: Winker (2017, Kap. 7.3), Malitte and Schreiber (2019, Kap. 4.2.4-4.2.9), Von Auer (2023, Kap. 5-6, 10), Adkins (2018, Kap. 3)

7. (Non-)Parametric Tests for Equality of Trend

- (a) t-Test for Independent and Paired Samples
- (b) Mann-Whitney Test
- (c) Wilcoxon Signed-Rank Test
- (d) Literature:

- i.
- ii. TBA

8. Regression with Dummy Variables: Modelling Socioeconomic Categories

- (a) Level Dummy
- (b) Slope Dummy
- (c) Interaction Terms
- (d) Literature:
 - i. James et al. (2023, Ch. 3.3.1)
 - ii. Adkins (2018, Ch. 7.1-7.2)
 - iii. Malitte and Schreiber (2019, Kap. 2.3.5, 4.4.3)
 - iv. Winker (2017, Kap. 9.1)
 - v. Von Auer (2023, Kap. 15.4)

9. Binary Classification Models

- (a) Logit and Probit Model
- (b) Estimation
- (c) Calculation and Interpretation of Marginal Effects
- (d) Goodness-of-Fit Measures
- (e) Literature:
 - i. Verbeek (2017, Ch. 7.1)
 - ii. James et al. (2023, Ch. 4.1-4.3)
 - iii. Adkins (2018, Ch. 16.1-16.3)

10. Unsupervised Learning

- (a) Dimension Reduction using Principal Component Analysis
- (b) k-means Algorithm for Cluster Analysis
- (c) Literature:
 - i. Greenacre et al. (2022)
 - ii. James et al. (2023, Ch. 12.1-12.2, 12.4)

4 Examination Format

The course concludes with a written exam lasting 90 minutes. If the exam is not passed, there is a resit opportunity.

Software

The open-source and free software Gretl will be used for the statistical and empirical analysis. This will be installed on the lab PCs. However, you can also install it on your private computer.

Make sure to use at least version 2024b.

Windows: <https://gretl.sourceforge.net/win32>

MAC OS X: <https://gretl.sourceforge.net/osx.html>

LINUX:

- Available in every good package manager. Installation on Debian-based systems via command line: `sudo apt-get install gretl`
- For nerds: Compile it yourself for Debian or Ubuntu:
https://github.com/atecon/install_gretl_ubuntu

References

Lee C. Adkins. *Using Gretl for Principles of Econometrics, 5th Edition*. Number 1412. Oklahoma State University, 2018. URL http://www.learneconometrics.com/gretl/using_gretl_for_POE5.pdf.

Erhard Cramer and Udo Kamps. *Grundlagen der Wahrscheinlichkeitsrechnung und Statistik: Eine Einführung für Studierende der Informatik, der Ingenieur- und Wirtschaftswissenschaften*. Springer, Berlin, Heidelberg, 5 edition, 2020. ISBN 978-3-662-60551-6 978-3-662-60552-3. doi: 10.1007/978-3-662-60552-3. URL <http://link.springer.com/10.1007/978-3-662-60552-3>.

Michael Greenacre, Patrick J. F. Groenen, Trevor Hastie, Alfonso Iodice D’Enza, Angelos Markos, and Elena Tuzhilina. Principal component analysis. *Nature Reviews Methods Primers*, 2(1):1–21, December 2022. ISSN 2662-8449. doi: 10.1038/s43586-022-00184-w. URL <https://www.nature.com/articles/s43586-022-00184-w>.

Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, and Jonathan Taylor. *An Introduction to Statistical Learning: With Applications in Python*. Springer, Cham, Switzerland, 1st ed. 2023 edition edition, July 2023. ISBN 978-3-031-38746-3. URL https://hastie.su.domains/ISLP/ISLP_website.pdf.download.html.

Jürgen Malitte and Sven Schreiber. *Ökonometrie verstehen mit Gretl: Eine Einführung mit Anwendungsbeispielen*. Springer Gabler, Berlin Heidelberg, 1. Aufl. 2019 edition edition, 2019.

Marno Verbeek. *A Guide to Modern Econometrics*. Wiley, Hoboken, NJ, 5 edition, July 2017. ISBN 978-1-119-40115-5.

Ludwig Von Auer. *Ökonometrie: Eine Einführung*. Springer Fachmedien, Wiesbaden, 2023. ISBN 978-3-658-42699-6 978-3-658-42700-9. doi: 10.1007/978-3-658-42700-9. URL <https://link.springer.com/10.1007/978-3-658-42700-9>.

Peter Winker. *Empirische Wirtschaftsforschung und Ökonometrie*. Springer, Berlin, Heidelberg, 2017. ISBN 978-3-662-49298-7 978-3-662-49299-4. doi: 10.1007/978-3-662-49299-4. URL <http://link.springer.com/10.1007/978-3-662-49299-4>.

Bin Yu and Rebecca L. Barter. *Veridical Data Science: The Practice of Responsible Data Analysis and Decision Making*. The MIT Press, Cambridge, Massachusetts, October 2024. ISBN 978-0-262-04919-1. URL <https://vdsbook.com/>.

Additional references

- Dougherty, C. (2016): *Introduction to Econometrics*, 5th ed., Oxford University Press, Oxford.
- Stock, J. H. and M. W. Watson (2020): *Introduction to Econometrics*, 4th ed., Pearson.

Additional Materials

- Video Lecture by Wooldridge: Econometrics for Economics, URL: <https://youtu.be/5lcQN-zbeGE?feature=shared>
- Additional materials on the Gretl project page: <https://github.com/gretl-project/material-on-gretl>
- Gretl Tutorials: <https://github.com/gretl-project/material-on-gretl/wiki>
- Gretl Cheat Sheet: https://github.com/gretl-project/gretl_cheatsheet/blob/master/datahandling.pdf