Amsterdam Business Research Institute

Multivariate Data Analysis

For Business and Management Research

Course Manual (Version 1.0)

Academic Year 2024 – 2025

Faculty
Prof. dr. Hester van Herk h.van.herk@vu.nl Course coordinator & lecturer

Target groups
The course Multivariate Data Analysis for Business and Management Research (MDA-MBR) 2024-2025 is open to PhD candidates, research master students, postdocs, and junior faculty. This is an advanced course that assumes prior knowledge on quantitative research methods and R (e.g., the ABRI course R for Business and management Research). The course workload represents 5 ECTS.

Course Content
This course will emphasize understanding, implementation, and interpretation of multivariate statistical methods. The course will involve both lectures and work tutorials. First, we discuss how to analyze and deal with missing data. Second, the course will start with fundamental multivariate techniques such as analysis of (co)variance and regression analysis including moderation and mediation, and factor analysis. Third, the main part of the course will be focused on learning some more advanced MDA techniques such as confirmatory factor analysis, structural equation modeling (SEM) and multi-level models (MLMs, also known as linear mixed models, hierarchical linear models, or mixed-effect models).

This course prepares the student for analyzing datasets using the freely available programming language R. R is a platform for which many scholars write packages. The basis enables you to manipulate data, clean data, and test hypotheses. The packages enable you to use advanced methods such as structural equation modeling and multilevel modeling. You will learn how to read various datasets (including files from SPSS or SAS) into R, and how to conduct manipulations such as transforming data.

Learning Objectives
Upon successful completion of the course, students will:
- Be able to evaluate and generate high-quality quantitative data, including making meaningful decisions in handling missing data and outliers.
- Critically assess the strengths and weaknesses of various multivariate analysis techniques, such as multiple regression, PCA, FA, structural equation modeling, and multilevel modeling.
- Perform multivariate analysis using various R-packages and apply them to their research projects.
- Effectively interpret and report the output of multivariate analyses.
- Demonstrate insights into reporting and publishing studies using these techniques in top-tier academic journals.

Course Design
The course consists of lectures, hands-on tutorials, student-led presentations, and discussions alternated with generic reflections on the materials when needed. It is very important that you apply what you have learned in the lectures and the tutorials. Practice is vital to understand the techniques learned and to be able to apply it yourself. We will meet twice a week. Each week, there will be homework including conducting multivariate analyses and interpreting the results which will be presented and discussed during the tutorials. Please prepare the tutorials by reading the theory and the assignment, and by

downloading the data in advance.

During the course you will work on two individual assignments. During week 1-2 you will work on the first assignment that will cover the content of the first two weeks. This assignment is handed in at the beginning of the third week (Monday 23:59) and will be discussed in the second class in the third week. The second assignment covers the contents of all weeks, with a focus on weeks 3-6. This assignment is handed in at the end of week 8 (Friday 23:59).

Assignment

Your overall course grade is based on two assignments and one presentation. During the course, you will work on the assignments. The assignments focus on performing the analyzes, interpreting the results, and being able to communicate about the results, i.e., writing a methods section in a scientific paper. The presentation requires you to interpret the methods and results session of selected papers and lead meaningful discussion. The theories behind the different models you estimate are not part of the assignments.

You submit the first assignment and the next lecture you present your results in class followed by a discussion of the findings. The first assignment will be graded by the lecturer. The second assignment is handed in after lectures and will be graded by the lecturer.

Grading

20% Presentation and Interpretation of output in lectures
30% Final grade assignment 1
50% Final grade assignment 2

The overall course grade needs to be 5.5 or higher.

The grading of the course consists of presentations and participation in class and two assignments. The final version of the second assignment is due Friday March 29, 2024.

Tuition Fee

Tuition fee (5 ECTS Course)   €1250
20% discount on early bird registration   €1000

Workload and credits

The estimated time participants spend on study activities is:

Attending Lectures and Interactive Assignment Sessions   24 hours
Studying Literature   60 hours
Peer review   16 hours
Completing the Assignments   40 hours

Total   *140 hours (5 ECTS)*

Session overview

Week	Dates	Topic	Literature	Assignments due
1	4 & 6 Feb	Data cleaning, missing data analysis, assumptions. Regression analysis	T&F: Chapter 4 (data Cleaning) 5 (Regression) C&F: Chapters 1-3, 4,7	Homework: data cleaning (Thursday) Student presentation on article 1 (Thursday).
2	11 & 13 Feb	PCA and Factor analysis Assessing reliability and validity	T&F: Chapter 13 (PCA and FA) OR E&H: Chapters 3 and 5 C&F: Chapter 8	Homework: Regression (Tuesday) Student presentation on article 2 (Thursday).
3	18 & 20 Feb	Confirmatory Factor Analysis	Rosseel (2012 & 2020) Iaccobucci (2009, 2010) E&H: Chapter 7 (7.1 – 7.3) C&F: Chapter 10 Beaujean (2014) Chapter 4	Hand in assignment 1 (Monday) Student feedback and discussion on assignment 1 (Thursday) Student presentation on article 3 (Thursday)
4	25 & 27 Feb	Structural Equation Modeling: multigroup	Rosseel (2012 & 2020) Iaccobucci (2009, 2010) Beaujean (2014) Chapter 2, 3, 4	Homework: CFA (Tuesday) Student presentation on article 4 (Thursday)
5	4 & 6 March	Structural Equation Modeling: multiple time periods	Rosseel (2012 & 2020) Iaccobucci (2009, 2010) Beaujean (2014) Chapter 2, 3, 5	Homework: SEM modelling (Tuesday) Student presentation on article 5 (Thursday)
6	11 & 13 March	Specific SEM models	C&F: Chapter 9 (9.3.1 + 9.3.5-9.3.7) T&F: Chapter 15 (additional reading); E &H Chapter 8 (additional reading) Beaujean (2014) Chapters 6-9 (additional reading)	Homework: SEM modelling (Tuesday) Reflection and discussion on assignment 2 and the overall course (Thursday)
7		Office hour (on appointment)		Office hour on assignments
8	**March 28**	**Deadline Assignments**		Hand-in final assignment + revised assignment 1

Literature

Books:

Tabachnick, Barbara G., and Linda S. Fidell (2014). *Using Multivariate Statistics*, Pearson New International Edition. (for sale at bol.com; at AMAZON as printed book and as an e-book on Kindle); a good reference on MVA

Everitt, B., & Hothorn, T. (2011). *An introduction to applied multivariate analysis with r* (Ser. Use r!). Springer. https://doi.org/10.1007/978-1-4419-9650-3 (e-book at VU library)

Beaujean, A. A. (2014). *Latent variable modeling using R: a step-by-step guide.* Routledge, Taylor & Francis Group. https://doi-org.vu-nl.idm.oclc.org/10.4324/9781315869780 (e-book at Vu library)

Chapman, C., & Feit, E. M. D. (2019). *R for marketing research and analytics* (Second, Ser. Use R!). Springer. https://link-springer-com.vu-nl.idm.oclc.org/book/10.1007%2F978-3-030-14316-9 (e-book at Vu library)

Articles (can all be downloaded from UBVU or Google Scholar):

Iacobucci, D. (2009). Everything you always wanted to know about SEM (structural equations modeling) but were afraid to ask. *Journal of Consumer Psychology, 19*(4), 673-680.

Iacobucci, D. (2010). Structural equations modeling: Fit indices, sample size, and advanced topics. *Journal of Consumer Psychology, 20*(1), 90-98.

Rosseel, Y., Oberski, D., Byrnes, J., Vanbrabant, L., Savalei, V., Merkle, E., ... & Chow, M. (2017). *Package 'lavaan'*. Retrieved July, 31, 2020.

Rosseel, Y. (2012). Lavaan: An R package for structural equation modeling and more. Version 0.5–12 (BETA). *Journal of statistical software, 48*(2), 1-36.

Additional reading

Hoyle, R. H. (2014). *Handbook of Structural Equation Modeling*. Guilford Publications.

Kline, R. B. (2023). *Principles and practice of structural equation modeling*. Guilford publications.

Finch, W. H., Bolin, J. E., & Kelley, K. (2019). *Multilevel modeling using R*. Crc Press.

Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods* (Vol. 1). sage.

Instructions for Presentations:

Two to three students will be assigned in one group to present one of the following articles. Each group will present for 15 minutes and then lead a 15-minute discussion based on the presented materials. The presentation will focus on the methodological and reporting results of the data analysis sections of the paper.

Articles for student presentations (in order of presentation; CONCEPT):

1. Ye, Q., Zhu, Y., Jin, Y., & Wang, D. (2023). Will there always be a return on investment? The effects of investment in employee development on employee entrepreneurship. *Journal of Vocational Behavior, 141*, 103843. https://doi.org/10.1016/j.jvb.2023.103843
2. Laguna, M., Mielniczuk, E., Razmus, W., Moriano, J. A., & J. Gorgievski, M. (2017). Cross-culture and gender invariance of the Warr (1990) job-related well-being measure. *Journal of Occupational and Organizational Psychology, 90*(1), 117-125. https://doi.org/10.1111/joop.12166
3. Kostopoulos, K., Papalexandris, A., Papachroni, M., & Ioannou, G. (2011). Absorptive capacity, innovation, and financial performance. *Journal of Business Research, 64*(12), 1335-1343. https://doi.org/10.1016/j.jbusres.2010.12.005
4. Matsuno, K., & Kohlbacher, F. (2019). Firms' (non)responses: The role of ambivalence in the case of population aging in Japan. *Long Range Planning, 52*(2), 236-254. https://doi.org/10.1016/j.lrp.2018.02.006
5. Glass, C., & Cook, A. (2018). Do women leaders promote positive change? Analyzing the effect of gender on business practices and diversity initiatives. *Human Resource Management*, *57*(4), 823-837.