Note: All course lectures are openly accessible on the course website and the units are available as playlists at [https://www.youtube.com/mronkko](https://www.youtube.com/mronkko)
1 COURSE STAFF AND CONTACT INFORMATION

Dr. Mikko Rönkkö
Course instructor
mikko.ronkko@aalto.fi
mikko.ronkko@jyu.fi

- All course assignments are available and returned through Aalto MyCourses.
- All articles and other reading materials are available through Zotero.
- Except for personal matters, all course communications are done through the course discussion forum at Aalto MyCourses.

2 OVERVIEW OF THE COURSE

This is a blended learning course that contains both online and in-person elements. Because of the COVID-19 pandemic, the course will by default run fully online and seminars and computer exercises are organized on Zoom. The course is organized by Aalto University and University of Jyväskylä and participants can obtain credits from either of these universities with a course code of their choice (TU-L0022/JSBJ1310/TJTJ7702).

The goal of the course is to develop an understanding of how statistical methods are used in management and other social research and how results are usually presented in journal articles. The course is designed for both those interested in just reading and understanding research done with statistical methods and for those who already use or plan to use statistical research methods in their own work.

During the course we will go through empirical papers published in Academy of Management Journal and Strategic Management Journal, and other high-quality journals and analyze how these papers were done. The methods and research designs used in these papers cover a majority of basic methods and designs used in these journals.

The analysis techniques covered during the course include regression analysis, its application moderation, mediation, and basic non-linear models, and factor analysis, focusing on exploratory factor analysis. Confirmatory factor analysis is explained on a surface level that is sufficient for its basic application and evaluation of published results. Extensions of these techniques, such as structural regression models (structural equation models), or multilevel models or other similar techniques for non-independent observations (e.g. longitudinal or multilevel data) are briefly introduced, but a more thorough study of these techniques is left for advanced courses.

The course consists of eight units, that each take two to four weeks and contain video lectures, online and in-person discussions, and assignments. The number of credits varies between 5-8 depending on which assignments students choose to complete. The content of each course component is explained later in the course brochure. The data analysis assignments can be completed with Stata, R, or SPSS, but SPSS is not recommended.

<table>
<thead>
<tr>
<th>Credits</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Pre-exam, mandatory video lectures, readings and written assignments 1, 6, and 7, data-analysis assignment 1, and learning diary. You must complete all assignments on time unless otherwise agreed.</td>
</tr>
<tr>
<td>+0.5 each</td>
<td>Written assignments 2, 3, 4, and 5</td>
</tr>
<tr>
<td>+0.5 each</td>
<td>Data analysis assignments 2 and 3</td>
</tr>
</tbody>
</table>

The number of credits is rounded down.
3 PARTICIPATION AND SIGNING UP

This course is targeted to industrial engineering and management doctoral students that have already taken the course TU-L0000 - Research Methods in Industrial Engineering or an equivalent introductory level general research methods course. Faculty or students from other universities are admitted if space permits.

You can sign up for the course using Oodi. Students from outside Aalto who do not have access to Oodi can sign up through MyCourses. Use the following URL and the enrolment key SRM2021 (in capital letters):


4 LEARNING OUTCOMES

The main goal of the course is to provide a foundation that enables participation on advanced courses and independent self-study of quantitative research methods. Instead of just explaining how the methods are used, we focus on why certain methods are used and how and why these methods work. Completing the 5-credit base module will introduce you to the logic of supporting causal claims with quantitative analyses, claiming measurement reliability and validity, simple hypothesis testing with linear regression analysis and its extensions, and basics of factor analysis.

The optional readings and written assignments are more challenging and recommended only for those who plan to use quantitative research methods in their own research. The two optional data analysis assignments will introduce you to using statistical software, data management and structuring a data-analysis project, as well as to the workflows of statistical analysis using the methods discussed during the course.

5 WORKLOAD

The workload calculation below is for the full 8 credit version of the course. If you want to complete all mandatory and optional assignments on the course, you should book about two full work days per week for the duration of the contact teaching period of the course (January-April)

<table>
<thead>
<tr>
<th>Content</th>
<th>Units</th>
<th>Workload</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-exam textbooks (pages, easy readings)</td>
<td>769</td>
<td>7 h / 100 pages</td>
<td>54</td>
</tr>
<tr>
<td>Video lectures (hours)</td>
<td>14</td>
<td>2 h / each hour of video</td>
<td>28</td>
</tr>
<tr>
<td>In-person meetings</td>
<td>7</td>
<td>3 + 4 hours each</td>
<td>49</td>
</tr>
<tr>
<td>Interactions on the course forum</td>
<td>8</td>
<td>1 hours per unit</td>
<td>8</td>
</tr>
<tr>
<td>Self-study related to lectures, incl. learning diary</td>
<td>7</td>
<td>3 hours each</td>
<td>49</td>
</tr>
<tr>
<td>Empirical articles (pages, easy reading)</td>
<td>109</td>
<td>7 h / 100 pages</td>
<td>8</td>
</tr>
<tr>
<td>Methodological literature (pages, challenging reading)</td>
<td>618</td>
<td>10 h / 100 pages</td>
<td>62</td>
</tr>
<tr>
<td>Written assignments</td>
<td>7</td>
<td>2 hours each</td>
<td>14</td>
</tr>
<tr>
<td>Data-analysis assignments</td>
<td>3</td>
<td>6 hours each</td>
<td>18</td>
</tr>
<tr>
<td>Total hours</td>
<td></td>
<td></td>
<td>291</td>
</tr>
</tbody>
</table>

1 Asko Karjalainen, Katarina Alha, and Suvi Jutila, Anna Aikaa Ajatella: Suomalaisten Yliopisto-opintojen Mittoitusjärjestelmä (Oulun yliopisto, opetuksen kehittämisyskikko, 2007).
6 COURSE CONTENT

The course consists of a pre-exam, a learning diary, readings and written assignments, data analysis assignments, video lectures, online interactions, seminar sessions, and computer classes. All assignments are distributed and returned through Aalto MyCourses where online interactions also take place.


The course is structured as eight units that are completed sequentially. At the beginning of a unit, the students receive a set of readings and video materials that they study independently. After this, the content and possible questions and thoughts that it raises are discussed on the course forum. Each unit concludes with a seminar where the materials are further discussed in-person. After each unit, the students complete a short reflection task and can optionally give feedback on the unit.

The different parts of the course are listed below:

6.1 Pre-exam (mandatory)

The pre-exam is a written exam that you must pass to be able to participate and get credits. The exam covers the following two books:


The exam consists of four questions. In the first question is term definitions, in which you need to define 8 terms from the course material. The three remaining questions are essays, chosen from a list provided on the MyCourses page. The exam questions are chosen randomly form a question pool that can be found on the course website.

6.2 Learning diary (mandatory)

The learning diary is for you to check that you have learned the key concepts and principles covered on the course. The list of questions is provided to you on the MyCourses page and you will work on the answers independently. You should work on the learning diary document soon after each class to write down how you understood the content of the classes and unit materials. The final version of the learning diary is returned one week after the last unit.

6.3 Readings and written assignments (3 mandatory, 4 optional)

The written assignments consist of reading methodological literature and empirical papers and then doing an assignment where you apply the methodological ideas that you just studied to analyze the empirical papers. You will be provided individual feedback on the written assignments and these are discussed in both the online and in-person interactions.

The written assignments 1, 5, and 7 are mandatory. The written assignments 2, 3, 4 and 6 are optional and can completed for extra credits. All returned written assignment should follow the American Psychological Association (APA) Publication Manual style for article manuscripts. All work will be checked for plagiarism using the TurnItIn service and will be returned to the students for revising if plagiarism problems are found.

6.4 Data-analysis assignments (1 mandatory, 2 optional)

The course has three data-analysis assignments. In each of the assignments, you will conduct a small data analysis project using a dataset provided by the course instructors. You should submit
a structured document containing the full analysis log along with a written explanation of the analyses you did, the thought process that lead to the analyses, and how you interpreted the results. All returned data analysis assignments will receive individual feedback.

The recommended software to use are Stata and R, but it is also possible (although not recommended) to do the assignments using SPSS and Excel. If you plan to do the course assignments using R, it is highly recommended that you do a tutorial (e.g. https://www.datacamp.com) on R before the course starts. The MyCourses page contains additional resources for familiarizing yourself with different statistical software before the start of the course.

The instruction for the data analysis assignments is done with screencasts that demonstrate an analysis or a technique that students then apply with their own computer complete the assignment. The purpose of the screencasts is to allow students to proceed at their own pace and also allows supporting multiple different statistical software on the course.

The course website contains more information for how to compile and submit a data analysis assignment document. The first assignment is mandatory and the assignments 2 and 3 are optional and can be completed for extra credit.

6.5 Video lectures (mandatory and optional)

The course follows a flipped classroom design and the lectures are delivered as videos that students watch on their own before online and in-person meetings with the instructor. The video library consists of about 80 videos forming a total of about 14 hours of content.

Each of the videos is assigned to a unit and the completion of watching the videos is tracked so that students can complete a unit only if they have watched all mandatory videos for that unit. The videos contain interactive content (e.g. quizzes) that must be completed successfully to complete the video.

6.6 Online interactions (mandatory)

Each unit contains mandatory online participation in the form of course forum discussion. At the beginning of each unit, the students are assigned the materials for that unit including readings, assignments, and video content. After a few days of familiarizing with the content, students are expected to post a question or a comment about the materials on the course forum. These questions and comments are then discussed online with the course instructor. To pass an online interaction session, a student must either start at least one discussion thread by posting a question or comment or reply to at least one thread started by someone else. Participation is graded.

Detailed instructions for how to participate online are delivered by email when the course forums open.

6.7 Seminar sessions (mandatory)

Each unit concludes with an in-person seminar. These seminars follow a flipped classroom design. Each seminar starts with an overview of the lecture materials that the students have viewed as videos in advance, but the focus is more on discussion and classroom assignments. You may miss one seminar without penalty to your grade.

6.8 Computer exercise sessions (optional and not graded)

The computer exercise sessions are optional and not graded. The course instructor is present to answer questions and give hand-to-hand guidance with the data analysis assignments. The first data-analysis assignment is designed so that it should be possible to complete if fully during the computer exercises sessions without working on the actual data analysis outside the class. In other words, the results files and analysis logs will be sufficient to complete the data-analysis
assignment for the unit. After the class the students should not need to do additional analyses, but simply write a document explaining the analyses and interpret the results.

In addition to working with data, we will do “manual calculations” without statistical software. Most statistical estimation involve minimizing or maximizing an estimation function. For example, least squares estimator minimizes the sum of squares of prediction errors (residuals) and maximum likelihood estimator maximizes the likelihood of the data given a hypothesized model. During these exercises, we specify the estimation functions in Excel and estimate the models by minimizing or maximizing this function with the Solver tool in Excel. The purpose of these assignments is to make the students understand how the analysis tools work in practice. While you are unlikely to encounter problems with linear regression, more advanced modeling techniques may not always work well or you could get nonsense results. In these scenarios understanding what the analysis software actually does is very important so that you can troubleshoot the analysis.

6.9 Reflection and feedback (mandatory and not graded)

Reflection is a key element of learning\(^2\). At the end of the unit it is good time to look back at what you have learned, where you did well, and what you can still improve on. After a student has completed all parts of the unit and received grades and feedback for all the submitted work, he/she is required to do a short reflection and feedback task where he/she evaluates his/her own learning and optionally gives feedback on the unit. This is a light task that should not take more than 30 minutes to complete, but of course a student can spend more time on this if he/she wishes.

7 UNITS AND SCHEDULE

The course consists of eight units. Each unit starts with a self-study of the materials, followed by online interactions where the materials are discussed on the course forum, and concludes with an in-person seminar and computer class. During the in-person teaching days, we will discuss theory and principles of quantitative research in the mornings and do hands-on assignments during the computer class in the afternoon. There will be no computer class on the seventh week, but we will instead discuss theory and principles for the full day.

Because of the pandemic, the course will run fully online and all seminars and computer classes are run on Zoom. The course schedule and locations are summarized in the table below. The contact teaching events are organized in TUAS-building, Maarintie 8, Espoo or in Agora building, Mattilanniemi 2, Jyväskylä. The seminar content is the same between the two locations and students can choose which of the two parallel seminars to participate in.

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Location</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.11</td>
<td>14:15-16</td>
<td>Zoom</td>
<td>Introductory lecture</td>
</tr>
<tr>
<td>3.11</td>
<td>14:15</td>
<td>Online</td>
<td>Course forum for unit 1 opens. The task is to write a forum post where you introduce yourself to others on the course.</td>
</tr>
<tr>
<td>9.12</td>
<td>9-12</td>
<td>Maarintie 8 (Aalto)</td>
<td>Course pre-exam</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Time</th>
<th>Location</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.12.-8.12.</td>
<td>eTentti (JYU)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td><strong>Christmas break</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td><strong>Weeks 51-52</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Unit 2: Causal inference, and basics of linear regression model</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Weeks 1-2</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.1.</td>
<td>Course forum for unit 2 opens</td>
<td>00:00</td>
<td>Online</td>
<td></td>
</tr>
<tr>
<td>11.1.</td>
<td>Deadline for written assignment 1 (mandatory)</td>
<td>23:59</td>
<td>Online</td>
<td></td>
</tr>
<tr>
<td>13.1.</td>
<td>Unit 2 seminar</td>
<td>9:15-12</td>
<td>Zoom</td>
<td></td>
</tr>
<tr>
<td>13.1.</td>
<td>Unit 2 computer class</td>
<td>13-17</td>
<td>Zoom</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Unit 3: Assumptions and diagnostics in linear regression models</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td><strong>Weeks 3-4</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18.1.</td>
<td>Course forum for unit 3 opens</td>
<td>00:00</td>
<td>Online</td>
<td></td>
</tr>
<tr>
<td>25.1.</td>
<td>Deadline for written assignment 2 (optional)</td>
<td>23:59</td>
<td>Online</td>
<td></td>
</tr>
<tr>
<td>27.1.</td>
<td>Unit 3 seminar</td>
<td>9:15-12</td>
<td>Zoom</td>
<td></td>
</tr>
<tr>
<td>27.1.</td>
<td>Unit 3 computer class</td>
<td>13:00-17</td>
<td>Zoom</td>
<td></td>
</tr>
<tr>
<td>31.1.</td>
<td>Deadline for data-analysis assignment 1 (mandatory)</td>
<td>23:59</td>
<td>Online</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Unit 4: Moderation, mediation, and instrumental variables</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td><strong>Week 5-6</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.2.</td>
<td>Course forum for unit 4 opens</td>
<td>00:00</td>
<td>Online</td>
<td></td>
</tr>
<tr>
<td>8.2.</td>
<td>Deadline for written assignment 3 (optional)</td>
<td>23:59</td>
<td>Online</td>
<td></td>
</tr>
<tr>
<td>10.2.</td>
<td>Unit 4 seminar</td>
<td>9:15-12</td>
<td>Zoom</td>
<td></td>
</tr>
<tr>
<td>10.2.</td>
<td>Unit 4 computer class</td>
<td>13-17</td>
<td>Zoom</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Unit 5: Extensions to regression: nonlinear, longitudinal, and multilevel models</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Weeks 7-8</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.2.</td>
<td>Course forum for unit 5 opens</td>
<td>00:00</td>
<td>Online</td>
<td></td>
</tr>
<tr>
<td>22.2.</td>
<td>Deadline for written assignment 4 (optional)</td>
<td>23:59</td>
<td>Online</td>
<td></td>
</tr>
<tr>
<td>24.2.</td>
<td>Unit 5 seminar</td>
<td>9:15-12</td>
<td>Zoom</td>
<td></td>
</tr>
<tr>
<td>24.2.</td>
<td>Unit 5 computer class</td>
<td>13-17</td>
<td>Zoom</td>
<td></td>
</tr>
<tr>
<td>28.2.</td>
<td>Deadline for data-analysis assignment 2 (optional)</td>
<td>23:59</td>
<td>Online</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Unit 6: Measurement</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Weeks 9-10</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.3.</td>
<td>Course forum for unit 6 opens</td>
<td>00:00</td>
<td>Online</td>
<td></td>
</tr>
<tr>
<td>8.3.</td>
<td>Deadline for written assignment 5 (optional)</td>
<td>23:59</td>
<td>Online</td>
<td></td>
</tr>
<tr>
<td>10.3.</td>
<td>Unit 6 seminar</td>
<td>9:15-12</td>
<td>Zoom</td>
<td></td>
</tr>
<tr>
<td>10.3.</td>
<td>Unit 6 computer class</td>
<td>13-17</td>
<td>Zoom</td>
<td></td>
</tr>
</tbody>
</table>
The detailed description of the eight units follows.

### 7.1 Unit 1: Course introduction

The purpose of this unit is to introduce the students to the work practices on the course. The students may not be familiar with working on a blended learning / online course, and this first unit will introduce the course tools (MyCourses/Moodle, Zotero, TurnItIn) and work practices. We will also discuss what the requirements for the written assignments are and go over the course plagiarism policy.

The unit concludes with the course pre-exam.

### 7.2 Unit 2: Causal inference, and basics of linear regression model

The unit introduces the course content, the principles of causal inference, and basics of linear regression models.

**Required readings:**


7.3 Unit 3: Assumptions and diagnostics in linear regression models

The unit discusses assumptions and principles behind regression analysis. We address the different assumptions and how some of them can be diagnosed empirically. Log transformation and dummy coding are introduced. Marginal prediction plots are introduced. The important concepts of endogeneity and model implied correlation matrix are introduced.

Optional readings:


7.4 Unit 4: Moderation, mediation, and instrumental variables

The unit continues from the previous unit with additional issues in linear regression models. We discuss the use of linear regression to estimate mediation and moderation models. Instrumental variables are introduced as a tool for addressing endogeneity.

Optional readings:


7.5 Unit 5: Extensions to regression: nonlinear, longitudinal, and multilevel models

The unit provides an introduction to various extensions of regression analysis. The techniques are covered on an introductory level. Generalized linear model, which is an extension to linear regression covering most commonly used single dependent variable models as special cases (e.g.
logistic regression, poisson regression, tobit regression, etc.). Maximum likelihood estimation is introduced. Cluster-robust standard errors are introduced as a technique for non-independent data (e.g. clustered, longitudinal data). We discuss regression techniques for estimating between, within, contextual, and population average effects using cluster means.

**Optional readings:**


### 7.6 Unit 6: Measurement

The unit discusses the concept of measurement, which refers to efforts to quantify abstract concepts such as innovativeness. We discuss reliability and validity and measurement theory. We address the conceptualization stage of measurement development. The unit introduces reliability statistics that can be used once unidimensionality has been established with factor analysis. The computer class covers basics of data management.

**Required readings:**


### 7.7 Unit 7: Factor analysis

The unit focuses on factor analysis. We will cover exploratory factor analysis in detail. Confirmatory factor analysis is introduced. Measurement theory is discussed on more detailed level and more advanced measurement models are introduced. Scale development procedures are discussed. Structural regression models are introduced.
Optional readings:
DeVellis, R. F. (2003). *Scale development theory and applications*. Thousand Oaks: Sage. (Chapters 5-6, more recent editions of the book will also do)


7.8 Unit 8: Research design, research ethics, and current issues

The unit we will address research design, research ethics, and current issues and debates in quantitative management research. We end with a summary of the course units. This unit concludes with a full day seminar.

Required readings:


8 GRADING

All submitted work will be graded between 1-5 and your grade will be a weighted average of the parts of the course that you completed.

<table>
<thead>
<tr>
<th>Course part</th>
<th>Weight</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-exam</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>Participation:</td>
<td>30%</td>
<td>By default, you will receive 2 for posting something on the course forum or being present at a seminar and your grade will increase based on your unit participation. In the video tasks, two lowest video scores are excluded for each unit.</td>
</tr>
<tr>
<td>Seminars, course forum, video tasks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learning diary</td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>Assignments</td>
<td>40%</td>
<td>Assignments contribute 40% to your grade regardless how many assignments you do. Each assignment is weighted equally.</td>
</tr>
<tr>
<td>Written assignments, data-analysis assignments</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

9 COURSE MATERIAL

The reading materials for the course are distributed through the Zotero reference management system. To get access to the materials:

1. Create an user account at Zotero.org
2. Email your username to the course instructor
3. The course instructor will send you an invitation to a group library, which you need to accept.

After you have accepted the invitation, you can access the material either online with a web browser or by installing the Zotero software on your computer. See the MyCourses page for information.

9.1 Books


1 250 pages total.

9.2 Articles


9.3 Empirical articles used as examples


Video: https://www.youtube.com/watch?v=NanlRlh1HR8 (1:40)


109 pages total

9.4 Other material


Video: [https://www.youtube.com/watch?v=5Dnw46eC0o](https://www.youtube.com/watch?v=5Dnw46eC0o) (11:47)

10 ABOUT THE INSTRUCTOR

Mikko Rönkkö is associate professor of entrepreneurship at Jyväskylä University School of Business and Economics and docent of management at Aalto University. He completed his Ph.D about misuse of structural equation modeling and other statistical techniques in management research at Aalto University in 2014. His current research interests are statistical research methods and software entrepreneurship. He has taught courses on statistical research methods in multiple universities in and outside of Finland. He has published in Organizational Research Methods, Psychological Methods, Journal of Operations Management, MIS Quarterly, among other journals. He is a department editor in Journal of Operations Management handling methodological articles and on the editorial boards of Organizational Research Methods and Entrepreneurship Theory and Practice.