**Discipline:** Marketing

**1 Lecturers**
Univ. Doc. Dr. Jörg Henseler (University of Cologne, Radboud University Nijmegen)
PD Dr. Christian M. Ringle (University of Hamburg)
Dr. Marko Sarstedt (Ludwig-Maximilians-University Munich)

**2 Title**
Latent Variables and Structural Equation Modeling

**3 Outline**

Issues
The course teaches the basic concepts of factor analysis as well as covariance- and variance-based structural equation modeling. After this course, participants will...

- ...be familiar with factor analytic techniques to uncover latent variables.
- ...understand the basic concepts of structural equation modeling, the covariance-based path modeling methodology and the PLS algorithm.
- ...know the reliability and validity measures that are relevant to evaluate structural equation modeling results.
- ...have a basic understanding of advanced analysis issues in structural equation modeling, including moderating effects, the identification and treatment of unobserved heterogeneity and multi-group comparisons.
- ...be able to use the software programs PASW (in the context of factor analysis), AMOS and SmartPLS to carry out fundamental analyses to successfully conduct their own research projects.

Course Format
The course will consist of a combination of lectures, exercise sessions, and a final exam. Lecturers will use recent journal articles as well as book chapters to teach the participants the state-of-the-art of research in structural equation modeling. Participants are responsible for reading the assigned materials before class.
4 Faculty

Univ. Doc. Dr. Jörg Henseler (University of Cologne, Radboud University Nijmegen)
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5 Administration

Schedule

**Day I: (Tuesday, July 27, 2010)**

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:00</td>
<td>Arrival of participants, reception, check-in and introduction</td>
</tr>
<tr>
<td>10:30</td>
<td>Recap: Elementary statistics and introduction to factor analysis</td>
</tr>
<tr>
<td>12:00</td>
<td>Lunch Break</td>
</tr>
<tr>
<td>13:00</td>
<td>Introduction to factor analysis (cont.) / Exercise session I:</td>
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<tr>
<td>14:30</td>
<td>Exploratory factor analysis using PASW Statistics</td>
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<tr>
<td>14:45</td>
<td>Short break</td>
</tr>
<tr>
<td>14:45</td>
<td>Conceptualization and Operationalization of Constructs in Business Research</td>
</tr>
<tr>
<td>16:15</td>
<td>Coffee break</td>
</tr>
<tr>
<td>16:45</td>
<td>Confirmatory Factor Analysis</td>
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</tbody>
</table>

**Day II (Wednesday, July 28, 2010)**

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
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</thead>
<tbody>
<tr>
<td>09:30</td>
<td>Exercise session I: Introduction to the AMOS software and applications of CFA</td>
</tr>
<tr>
<td>11:00</td>
<td>Short break</td>
</tr>
<tr>
<td>11:15</td>
<td>Essentials of Covariance-based SEM</td>
</tr>
<tr>
<td>12:45</td>
<td>Lunch break</td>
</tr>
<tr>
<td>14:00</td>
<td>Exercise session II: Introduction to the AMOS software and applications</td>
</tr>
<tr>
<td>15:30</td>
<td>Coffee break</td>
</tr>
<tr>
<td>16:00</td>
<td>Advanced topics in SEM, Multigroup analysis</td>
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</tbody>
</table>
Day III (Thursday, July 29, 2010)

09:30 – 11:00  Fundamentals of PLS path modeling / Assessment of measurement results

11:00 – 11:15  Short break

11:15 – 12:45  Assessment of measurement results (cont.)

12:45 – 14:00  Lunch break

14:00 – 15:30  Exercise session I: Introduction to the SmartPLS software and applications

15:30 – 16:00  Coffee break

16:00 – 17:30  Exercise session II: Example applications in business research

Day IV (Friday, July 30, 2010)

09:30 – 11:00  Advanced topics in PLS path modeling

11:00 – 11:15  Short break

11:15 – 12:00  Recap

12:00 – 13:30  Lunch break

13:30 – 15:00  In-class exam

15:00 – 15:30  Wrap-up & Feedback

Location
Ludwig-Maximilians-University Munich
Computer Lab (CIP III)
Ludwigstr. 28 / rear building, ground floor
80539 Munich

Max. Number of Participants
The number of participants is limited to 15-20.

Cost
tba
6 Content

Use of the multivariate statistical technique of factor analysis increased during the past decade in all fields of business-related research. As the number of variables to be considered in multivariate techniques increases, so does the need for knowledge of the structure and interrelationships of the variables. Factor analysis can be utilized to examine the underlying patterns or relationships for a large number of variables and to determine whether the information can be condensed or summarized in a smaller set of factors or components.

Structural equation modeling depicts an extension of the classical factor analysis which allows explaining relationships among latent variables (constructs). Thus, it allows to empirically validate theoretically established causal models in the various social science disciplines such as marketing (e.g., to perform research on brand equity, consumer behavior, and customer satisfaction) or management (e.g., to evaluate factors that influence alliance networks on firm performance).

Covariance-based structural equation modeling (CBSEM) and partial least squares analysis (PLS) path modeling constitute the two matching statistical techniques for estimating structural equation models. Both apply to the same class of models - structural equations with unobservable variables and measurement error - but they have different structures and objectives.

For example, the goal of CBSEM is to account for observed covariances (theory testing), whereas PLS rather aims at explaining variances (prediction-oriented character). Furthermore, CBSEM offers statistical precision in the context of stringent assumptions while PLS trades parameter efficiency for prediction accuracy, simplicity, and fewer assumptions. Lastly, CBSEM requires relatively large samples for accurate estimation and relatively few variables and constructs for convergence.

The objective of this course is to define and explain in broad, conceptual terms the fundamental aspects of factor analytic techniques. More precisely, it aims at providing an in-depth methodological introduction into the factor analysis, CBSEM and PLS path modeling approach (the nature of causal modeling, analytical objectives, some statistics), including the evaluation of analysis results, and an introduction to complementary analytical techniques. Practical applications and the use of the software applications PASW Statistics (http://www.pasw.com), AMOS (http://www.spss.com/de/Amos/) and SmartPLS (http://www.smartpls.de) are an integral part of this course.
7 Prerequisites
The course requires basic skills in statistics and multivariate data analysis techniques. Concepts such as mean values, standard deviations and covariance matrices should sound familiar to the participants. In addition, a basic understanding of factor analytic approaches, regression analysis as well as testing procedures is helpful but not an essential requirement for understanding the contents. A recap session on elementary statistics is integrated at the beginning of the course.

8 Course Material
Essential Reading Material

8.1.1 Factor Analysis & Construct Development

8.1.2 CBSEM
8.1.3 PLS path modeling


Additional Reading Material


9 To Prepare
All participants are required to read the essential reading material prior to the course. If participants wish to catch up on elementary statistics and data analysis they should revert to Fahrmeir et al. (2009; Statistik) and Backhaus et al. (2008; Multivariate Analysemethoden). We also strongly recommend Schlittgen (2009; Multivariate Statistik).

10 Assessment
A 90-minute in-class exam will be offered at day IV.

11 Credits
The course (including the exam) is eligible for 6 ECTS.