



# Module Guide

in accordance with the examination regulations concerning the starts of course in October and April as of April 25<sup>th</sup>, 2017 and November 20, 2017.

**M. Sc. part-time program**  
**Big Data & Business Analytics**

**School of Information, Media and Design**

**Effective: September 23<sup>rd</sup>, 2017**

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## SRH University Heidelberg, M. Sc. part-time program Big Data & Business Analytics

### Module 3035 – First Steps into Case Studies

Semester	Annually offered	Duration (weeks)	Type	ECTS Points	Student's workload (1 ECTS appropriates 25 h; for exceptions view appendix 2b of the examination regulations)
1	2x	5	Compulsory module	6	<ul style="list-style-type: none"> <li>- 150 hours, thereof:</li> <li>- 30 in class,</li> <li>- 105 private studies,</li> <li>- 15 coaching</li> </ul>
Requirements for enrolment	Applicability	Type(s) of Exam	Teaching and learning methods	Module coordinator	
None	In all following modules	<ul style="list-style-type: none"> <li>- Project work and development</li> <li>- Learning diary</li> </ul>	<ul style="list-style-type: none"> <li>- Data research,- analysis and preparation</li> <li>- Case studies</li> <li>- Team work</li> <li>- Problem-oriented learning</li> <li>- Exercises</li> </ul>	Prof. Dr. Herbert Schuster Frank Schulz	
Learning objectives					

#### Abstract

The main function of this module is to lay the essential knowledge foundation for all later modules. Students analyze various practical examples of Big Data projects and as teams they perform well-defined Big Data case studies which involve the whole process of a Big Data project: Definition of a discrete problem within a business – Data acquisition and cleansing – Data saving – Data analysis and interpretation – Data visualization and communication of the results provided by Data analytics - Recommendation of further actions. This setup enables the Big Data project being embedded into a business context. Thus, Students are enabled to interconnect commercial necessities and decision making with ethical issues during the Big Data project, which vice versa avoids an approach exclusively catering technical as well as analytical requirements. The datasets

used in the case studies are prepared by the SRH University and distributed to the students using a cloud platform. The concepts, methods and tools learned in this module will be repeated and intensified in the following modules – this especially affects the modules Case Studies I and II. Parallel to the Case Studies the students are taught basic scientific competences: They understand the essential aspects of scientific work and are able to plan and structure a scientific process. Furthermore, they show profound knowledge in the application of tools and methods during the scientific writing process.

#### Learning outcomes Specialist Competence

- | The students know the fundamental aspects of Big Data science.
- | They are able to define the “five Vs” of Big Data (Volume, Velocity, Variety, Value and Veracity) as well as the different phases of a Big Data project. They may explain them in well-defined practical sessions in an application-oriented manner.
- | They know diverse practical examples of Big Data projects and are able to explain their approach in business context as well as to compare with each other.
- | They understand the different phases of a Big Data project and may explain them in context with Big Data projects.
- | They are able to structure their scientific work as well as their results
- | They gain results based on appropriate scientific criteria, e.g. objectivity, validity and reliability.

#### Learning outcomes Method Competence

- | The students are able to understand various types of project management and may apply as well as validate their knowledge in teams. Moreover, they understand the connection between business offers and the Big Data Life Cycle.

#### Learning outcomes Social Competence:

- | The students know the fundamental tools to organize working processes in virtual teams as well as approaches dealing with team-internal conflicts. They are able to use both tools to accomplish results mutually.

#### Learning outcomes Personal Competence

- | The students are able to take their role within the virtual team parallel to their occupational activities and organize multiple tasks (i.e. occupation, private life and studies) simultaneously.

### Course content catering the aforementioned competences

- | Five Vs: Volume, Velocity, Variety, Value and Veracity
- | Big Data Life Cycle: Generation and collection of data, Data processing and storage, Data analysis, publishing, archiving and recall.
- | Best Practices
- | Cloud Computing
- | Spectrum of Big Data solutions on the market: Hadoop / Map Reduce / Spark / AWS / Google / R or SAS / Lumira or Tableau
- | Organization and management of Big Data projects
- | Principles of scientific work
  - o Scientific quality criteria
  - o Scientific Methodology
  - o Criteria to evaluate scientific works
  - o Research, classification and evaluation of scientific literature
  - o Scientific writing
  - o Lead and host academic discussions

### Recommended literature for preparation and follow-up

- | Dorschel J: Praxishandbuch Big Data. Wirtschaft-Recht-Technik, Springer Gabler, Heidelberg, 2015
- | Freiknecht J: Big Data in der Praxis: Lösungen mit Hadoop, Hbase und Hive. Daten speichern, aufbereiten, visualisieren, 2014.

### *Scientific work*

- | Balzert H, Schäfer C, Schröder M, Kern U: Wissenschaftliches Arbeiten, W3L GmbH, 2008
- | Franck N, Stary J: Die Technik wissenschaftlichen Arbeitens, UTB,. 2009.
- | Karmasin M, Ribing R: Die Gestaltung wissenschaftlicher Arbeiten: Ein Leitfaden für Seminararbeiten, Bachelor-, Master- und Magisterarbeiten sowie Dissertationen, UTB, 2012
- | Oehrich M: Wissenschaftliches Arbeiten und Schreiben. Schritt für Schritt zur Bachelor- und Master-Thesis in den Wirtschaftswissenschaften, Springer Gabler, Heidelberg, 2015
- | Theisen MR: Wissenschaftliches Arbeiten: Erfolgreich bei Bachelor- und Masterarbeiten, , München 2013

### *Links*

- | Google Scholar
- | DBLP
- | IEEE Computer Society
- | IEEE TVCG camera ready document guidelines

### *Literature management software*

- | Citavi

## Constructive Alignment

Using the examination types Project work, development and learn journal the students are given the opportunity to reflect and document practically their progress in learning as well as their scientific abilities. Through the analysis of practical examples and the performance of a complete case study using the business perspective as well as the multiple forms of Data handling (Choice, evaluation, cleansing, providing, analysis and communication) the students get a first glimpse of the technical, organizational and methodological principals of Big Data and are also able to interconnect them directly with the different aspects and phase of a Big Data project. Another aspect for the choice of the aforementioned examination types is that they enable a step-by-step improvement in skills and fit optimally to the practice oriented character of this module. Virtual teams are formed to enable the studiability parallel to the students' main occupation. These teams are provided the main course material (data, software, scripts, literature) via a cloud platform and they may also store and share their progresses. Additional coaching of the teams during the module is provided via live chats and e-learning.

### SRH University Heidelberg, M. Sc. part-time program Big Data & Business Analytics

#### Module 3036 – Case Studies 1

Semester	Annually offered	Duration (weeks)	Type	ECTS points	Student's workload (1 ECTS appropriates 25 h; For exceptions view appendix 2b of the examination regulations)
2	2x	20	Compulsory module	8	<ul style="list-style-type: none"> <li>- 200 hours, thereof:</li> <li>- 20 in class,</li> <li>- 140 private studies,</li> <li>- 40 coaching</li> </ul>
Requirements for enrolment	Applicability	Type(s) of exam	Teaching and learning methods	Module coordinator	
<ul style="list-style-type: none"> <li>- First Steps Into Case Studies</li> <li>- Data Engineering</li> <li>- Analytics II</li> </ul>	In all following modules	<ul style="list-style-type: none"> <li>- Project work and development</li> <li>- Presentation</li> </ul>	<ul style="list-style-type: none"> <li>- Data research,- analysis and preparation</li> <li>- Case study</li> <li>- Working in teams</li> <li>- Exercises</li> </ul>	Prof. Dr. Herbert Schuster Frank Schulz	

## Learning objectives

### Abstract:

Similar to the module "First Steps Into Case Studies", a Big Data project is performed during Case Studies 1, with the difference that the focus lays on specific company compartments: Marketing, production, logistics and sales management. The main methodology used in "Case Studies 1" originates from data mining. In the beginning of the module the students are given the task to develop a Big Data question out of a specific company problem. It is a key element of Big Data projects to pose good and adequate questions; this crucial step is maintained by creativity techniques. Subsequently, a Big Data project is planned and executed to solve this question. Finally, the results of this analysis are visualized and used to develop further guidance.

This project is accompanied by the modules "Data Storytelling and communication" and "Privacy, Ethics and International Law".

The case studies base on the competencies and skills gained from the modules "First Steps Into Case Studies" and "Data Engineering". Basic knowledge in the fields "Data Management" and "Design Principles" are recommended but not required. Additional theoretical input in Data visualization originates from the module "Data Storytelling and Communication". It is no prerequisite to successfully accomplish the module "Data Storytelling and Communication" to complete "Case Studies 1".

As in "First Steps Into Case Studies", the case studies are performed within virtual teams, who interact with each other via cloud solutions. Each team is coached by the professors using live chat and synchronous E-learning.

### Learning outcomes Specialist Competence:

- | The students are able to transfer a company problem into a Big Data question as well as planning and performing it afterwards.
- | They identify the data being necessary for this question and are able to estimate properly the value of the data in context of the problem.
- | They may prepare data for Data Mining.
- | They execute a data mining analysis with the help of established tools and software.
- | They are capable to adequately visualize and communicate the results in context of the developed problem

### Learning outcomes Method Competence:

- | The students are able to specifically apply creativity techniques to develop a problem and to identify

required data.

- | They evaluate properly the applicability of methods and tools for the different phases of the Big Data project in context of a certain project and are able to select and execute the adequate methods.
- | They interpret and evaluate the results of the analytics process with regard to the developed Big Data problem

Learning outcomes Social Competence:

- | The students know the fundamental tools to organize working processes in virtual teams as well approaches dealing with team-intern conflicts. They are able to use both tools to accomplish results mutually.

Learning outcomes Personal Competence:

- | The students are able to take their role within the virtual team parallel to their occupational activities and organize multiple tasks (i.e. occupation, private life and studies) simultaneously.

## Course content

### Course content catering the aforementioned competences

- | Project management
- | Organization and management
- | Creativity techniques and formulations of problems
- | Big Data architectures
- | Data Mining / Text Mining
- | Storage and Retrieval Tools
- | Data Mining Tools, methods and techniques

### Recommended literature for preparation and follow-up:

- | Dorschel J: Praxishandbuch Big Data. Wirtschaft-Recht-Technik, Springer Gabler, Heidelberg 2015.
- | Ester, M & Sander J: Knowledge Discovery in Databases. Techniken und Anwendungen. Springer, Berlin, 2000.
- | Ferber R: Information Retrieval. Suchmodelle und Data Mining - Verfahren für Textsammlungen und das Web, dpunkt.verlag, Heidelberg, 2003.
- | Fischer P: Algorithmisches Lernen, B.G. Teubner, Stuttgart, 1999.
- | Freiknecht J: Big Data in der Praxis: Lösungen mit Hadoop, Hbase und Hive. Daten speichern, aufbereiten, visualisieren, 2014.
- | Han J *et al.*: Data Mining: Concepts and Techniques, Elsevier/Morgan Kaufmann, Amsterdam, 2006.
- | Hand D. *et al.*: Principles of Data Mining, MIT Press, Cambridge (Mass.)/London, 2001.
- | Kantardzic M: Data Mining, Wiley, 2011.
- | Koster K: International Project Management, Sage Publications Ltd., 2009.
- | Liu B: Web Data Mining: Exploring Hyperlinks, Contents and Usage Data (Data-Centric Systems and Applications), 2. Auflage, Springer, 2011.
- | Marsland S: Machine Learning - An Algorithmic Perspective, CRC Press, 2009.
- | Meyer H & Reher HJ: Projektmanagement: Von der Definition über die Projektplanung zum erfolgreichen Abschluss, Springer Verlag, 2016.
- | Mitchell TM: Machine Learning, McGraw-Hill, 1997.
- | Runkler TA: Data Mining - Methoden und Algorithmen intelligenter Datenanalyse, Springer Vieweg, 2010.
- | Schwarz T: Big Data im Marketing: Chancen und Möglichkeiten für eine effektive Kundenansprache, Haufe-Lexware, Freiburg, 2015.
- | Witten IHa *et al.*: Data Mining: Practical Machine Learning, Tools and Techniques, 3<sup>rd</sup> edition, Elsevier, 2011.
- | Witten IH & Frank E: Data Mining, Hanser, 2001.

Constructive alignment

The examination forms project work and presentation evaluates the students' abilities to application-specifically document their learning progress. Through the application of the skills and competencies acquired in the previous modules during "case studies 1" the students are given the opportunity to intensify their knowledge in a holistic manner. Furthermore, the students learn to evaluate the applicability and cooperation of methods, techniques and tools in a context of a certain project. The project work is an adequate examination for project module because of its emphasis on the visualization and communication of the results/recommendations.

**SRH University Heidelberg, M. Sc. part-time program Big Data & Business Analytics**

Module 3037 – Case Studies 2

Semester	Annually offered	Duration (weeks)	Type	ECTS points	Student's workload (1 ECTS appropriates 25 h; For exceptions view appendix 2b of the examination regulations)
3	2x	20	Compulsory module	8	<ul style="list-style-type: none"> <li>- 200 hours, thereof:</li> <li>- 20 in class,</li> <li>- 140 private studies,</li> <li>- 40 coaching</li> </ul>
Requirements for enrolment	Applicability	Type(s) of exam	Teaching and learning methods	Module coordinator	
<ul style="list-style-type: none"> <li>- First Steps In Case Studies</li> <li>- Data Engineering</li> <li>- Analytics II</li> </ul>	In all following modules	<ul style="list-style-type: none"> <li>- Project work and development</li> <li>- Presentation</li> </ul>	<ul style="list-style-type: none"> <li>- Data research, analysis and processing</li> <li>- Project work</li> <li>- Team work</li> <li>- Learning diary</li> </ul>	Prof. Dr. Herbert Schuster Frank Schulz	

Learning objectives

Abstract

Similar to the case studies in the modules "First Steps Into Case Studies" and "Case Studies 1", the module

"Case studies 2" includes the generation of a Big Data problem which lays the foundation for a Big Data project. The results gained from this project are visualized and communicated as a business-oriented advice. The main focus of the Big Data projects performed in "Case Studies 2" lays on predictive analytics. Additional theoretical input is provided by the simultaneously occurring modules "Data Storytelling and Communication", "Data Management: Data curation and modelling" and "Analytics III: Predictive Analytics". The results acquired from the former two case study modules are also implemented in "Case Studies 2". Fundamental knowledge in "Design Principals" is favorable, but not a prerequisite. The successful accomplishment of "Data Storytelling and Communication" is not required to complete "Case studies 2". As in the case studies of the previous two semesters the Big Data projects are performed in virtual teams which are interconnected via cloud solutions. Additionally, the groups are coached by the teaching staff via live chat and synchronous E-Learning

Learning outcomes Specialist Competence:

- | The students are able to transfer a company problem into a Big Data question as well as planning and performing it afterwards.
- | They identify the data being necessary for this question and are able to estimate properly the value of the data in context of the problem.
- | They may prepare data for Predictive analytics.
- | They execute a predictive analysis with the help of established tools and software.
- | They are capable to adequately visualize and communicate the results in context of the developed problem

Learning outcomes Method Competence:

- | The students are able to specifically apply creativity techniques to develop a problem and to identify required data.
- | They evaluate properly the applicability of methods and tools for the different phases of the Big Data project in context of a certain project and are able to select and execute the adequate methods.
- | They interpret and evaluate the results of the analytics process with regard to the developed Big Data problem

Learning outcomes Social Competence:

- | The students know the fundamental tools to organize working processes in virtual teams as well approaches dealing with team-internal conflicts. They are able to use both tools to accomplish results mutually.

Learning outcomes Personal Competence:

- | The students are able to take their role within the virtual team parallel to their occupational activities and organize multiple tasks (i.e. occupation, private life and studies) simultaneously.

## Course content

### Course content catering the aforementioned competences

- | Project management
- | Organization and management
- | Creativity techniques, formulation of questions
- | Data management
- | Big Data architectures
- | Predictive analytics tools
- | Data mining tools
- | Visualization tools
- | Predictive Analytics
- | Ethics
- | Predictive Customer Insight

### Recommended literature for preparation and follow-up:

- | Chamoni P & Gluchowski P: Analytische Informationssysteme: Business Intelligence-Technologien und -Anwendungen, akt. Auflage.
- | Dorschel J: Praxishandbuch Big Data: Wirtschaft-Recht-Technik, Springer Gabler, Heidelberg, 2015.
- | Freiknecht J: Big Data in der Praxis: Lösungen mit Hadoop, Hbase und Hive. Daten speichern, aufbereiten, visualisieren, 2014.
- | Kemper *et al.*: Business Intelligence - Grundlagen und praktische Anwendungen, 3. Auflage, Vieweg, Wiesbaden, 2010.
- | Koster K: International Project Management, Sage Publications Ltd., 2009.
- | Meyer H & Reher HJ: Projektmanagement: Von der Definition über die Projektplanung zum erfolgreichen Abschluss, Springer Verlag, 2016.
- | Rausch P *et al.*: Business Intelligence and Performance Management: Theory, Systems and Industrial Applications, Springer Verlag, 2013.

## Constructive Alignment

The examination forms project work and presentation evaluates the students' abilities to application-specifically document their learning progress. Through the application of the skills and competencies acquired in the previous modules during "case studies 2" the students are given the opportunity to intensify their knowledge in a holistic manner. Furthermore, the students learn to evaluate the applicability and cooperation of methods, techniques and tools in a context of a certain project. The project work is an adequate examination for project module because of its emphasis on the visualization and communication of the results/recommendations. Moreover, the students proof their ability to communicate the recommendations based on the results of the case studies via the final presentations. By documenting their progresses within the module using a learn

journal the students are given the opportunity to solve problems in a self-reflecting manner.

**SRH University Heidelberg, M. Sc. part-time program Big Data & Business Analytics**

Module 3038 – Data Engineering

Semester	Annually offered	Duration (weeks)	Type	ECTS points	Student's workload (1 ECTS appropriates 25 h; For exceptions view appendix 2b of the examination regulations)
1	2x	5	Compulsory module	5	<ul style="list-style-type: none"> <li>- 125 hours, thereof:</li> <li>- 25 in class,</li> <li>- 87,5 private studies,</li> <li>- 12,5 coaching</li> </ul>
Requirements for enrolment	Applicability	Type(s) of exam	Teaching and learning methods	Module coordinator	
None	In all following modules	<ul style="list-style-type: none"> <li>- Project work</li> <li>- Presentation</li> </ul>	<ul style="list-style-type: none"> <li>- Individual work</li> <li>- Seminar</li> <li>- Team work</li> <li>- Problem-oriented learning</li> </ul>	Frank Schulz	

Learning objectives

Abstract:

This course can be seen as an engineering tool within a Big Data project.

The engineering basis of Big Data projects is contributed by the storage and provision of big data amounts. A central objective of this module is to acquaint the students with the technical fundamentals of Big Data used for data storage and retrieval as well as to provide them with an overview of typical Big Data architectures. Within this overview, standard technologies and concepts like e.g. No-SQL databases, In-Memory Computing, Hadoop, Map-Reduce as well as distributed data processing are introduced. Big Data architecture vary in dependency of the Problem to be solved; this differences are to be analyzed using practical examples.

Learning outcomes Specialist Competence:

- | The students know common Big Data architectures.
- | After completion of this module the students are able to distinguish between common Big Data architectures
- | They are capable of planning and constructing a complete Big Data architecture for storage and provision of big data amounts in dependence of the application context.
- | They evaluate, sort and select Big Data technologies adequately regarding the initial Big Data problem.

Learning outcomes Method Competence:

- | The students increase their competences in problem solving.

Learning outcomes Social Competence:

- | The students intensify their ability to work in virtual teams and are also capable to use the knowledge and abilities distributed amongst the team to solve a problem in a target-oriented manner.

Learning outcomes Personal Competence:

- | The students improve their competence to detect and close gaps in knowledge independently.

## Course content

### Course content catering the aforementioned competences:

- | Hadoop and Map Reduce
- | No-SQL databases (Key Value Stores, Graph Databases, Document Stores, Columnar Databases)
- | CAP Theorem, BASE Principle
- | In-Memory Computing
- | Real-time data streams
- | Stream Processing, Batch Processing
- | Data Warehousing
- | Scalability
- | Lambda architecture
- | Edge Processing

### Recommended literature for preparation and follow-up:

- | Bengtfort B & Kim J: Data Analytics with Hadoop: An Introduction for Data Scientists, O'Reilly, 2016
- | Freiknecht J: Big Data in der Praxis: Lösungen mit Hadoop, Hbase und Hive. Daten speichern, aufbereiten, visualisieren, Carl Hanser Verlag GmbH und Co. KG, 2014.
- | Grus J: Data Science from Scratch, O'Reilly , 2015
- | Redmond E & Wilson JR: Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement, Pragmatic Bookshelf, 2012.
- | White T: Hadoop: The Definite Guide, O'Reilly, 2015.
- | Recent research literature from peer-reviewed journals

## Constructive Alignment

Beginning with the initial problem to construct big data architecture for a specific application scenario, the students develop the required know-how to plan and construct an adequate architecture. For this purpose they first collect the knowledge and skills distributed within the team and are able to detect and close knowledge as well as competence gaps. This module is also accompanied by the analysis of practical examples and exercises concerning the most common big data technologies. Using the examination form practical journal and presentation the students document their learning improvements continually and finally defend them in their presentations.

## SRH University Heidelberg, M. Sc. part-time program Big Data & Business Analytics

### Module 3039 – Data Management

Semester	Annually offered	Duration (weeks)	Type	ECTS points	Student's workload (1 ECTS appropriates 25 h; For exceptions view appendix 2b of the examination regulations)
1 & 3	2x	15	Compulsory module	8	<ul style="list-style-type: none"> <li>- 200 hours, thereof:</li> <li>- 40 in class,</li> <li>- 140 private studies,</li> <li>- 20 coaching</li> </ul>
Requirements for enrolment	Applicability	Type(s) of exam	Teaching and learning methods	Module coordinator	
none	<ul style="list-style-type: none"> <li>- Case studies 1</li> <li>- Case studies 2</li> <li>- M. Sc. project</li> </ul>	<ul style="list-style-type: none"> <li>- Project work/development</li> <li>- Presentation</li> </ul>	<ul style="list-style-type: none"> <li>- Individual work</li> <li>- Team work</li> <li>- Exercises</li> <li>- Lecture</li> </ul>	Prof. Dr. Barbara Sprick	

#### Learning objectives

#### Abstract:

The module Data management addresses data acquisition, management and curation.

Through the digitalization of information, implementation of sensors in items of daily use, the mutual communication of systems (Internet of Things) as well as the utilization of social networks, the amount of produced and collected data increases steadily. However, there is a huge heterogeneity in type (time series, text and image files, audio and video files, spreadsheets, etc.) as well as quantity within the data collected in this manner.

For a useful generation of knowledge out of raw data, the latter needs to be cleansed, enhanced, organized, described, etc. in the manner according to the project objective. The main aim of Data management and curation is to model, cleanse and prepare heterogeneous data originating from different sources – this includes structured as well as semi-structured data sources.

The principles of data management are taught in the first semester as well as in Case Studies 1. In the beginning, the students train the foundations of data management in individual exercise units using raw data provided by the SRH University.

New, more complex aspects of data curation are added during the third semester, which enables the students to model, enhance and densify huge data amounts by using metadata knowledge. This is achieved in such a manner so that the data value is increased significantly, thus leading Big Data being transformed into Smart Data. The SRH University provides raw data for exercise purposes which are to be prepared and modelled by the students for a specifically defined application context.

#### Learning outcomes Specialist Competence:

- | After completion of this Module the students know methods and technologies of the management and curation of huge data amounts.
- | The students apply methods and technologies for managing and curation of different kinds of huge data amounts.
- | They are able to evaluate the quality (i.e. veracity, validity) and the benefit (value) of data regarding a well-defined scenario.
- | They may integrate data from different sources and formats.
- | They are able to cleanse, homogenize, aggregate and prepare adequately collected data according to a well-defined application context.
- | They know the importance of metadata for the value of data amounts and are able to evaluate the significance of specific metadata in context of a certain scenario.

#### Learning outcomes Method Competence:

- | The students know methods and tools for managing and curating data and are able to use a certain spectrum of them.

#### Learning outcomes Social Competence:

- | The students intensify their ability to work in virtual teams and are also capable to use the knowledge and abilities distributed amongst the team to solve a problem in a target-oriented manner.

#### Learning outcomes Personal Competence:

- | The students improve their competence to detect and close gaps in knowledge independently

## Course content

### Course content catering the aforementioned competences:

- | Data identification, verification, cleansing, transformation and integration
- | Big Data Variety
- | Streaming data
- | Batch processing
- | Data quality
- | Data source categories
- | Internet of Things
- | Data formatting, scheme-mapping, cleansing
- | Time series
- | Metadata
- | Data Aging, Data Lifecycle Management
- | Data profiling
- | ETL processes
- | syntactic und semantic data transformation

### Recommended literature for preparation and follow-up:

- | Recent research literature from peer-reviewed journals
- | Cielen D & Meysman A: Introducing Data Science, Manning Verlag, 2016
- | Garofalakis M & Gehrke J: Data Stream Management: Processing High-Speed Data Streams (Data-Centric Systems and Applications), Springer Verlag, 2016
- | Kamball R & Caserta J: The Data Warehouse ETL Toolkit: Practical Techniques for Extracting, Cleaning, Conforming, and Delivering Data, Kimball Group, 2004
- | Lindstrom M: Small Data: Was Kunden wirklich wollen - wie man aus Hinweisen geniale Schlüsse zieht, Plassen Verlag, 2016
- | Mitchell MN: Data Management Using Stata: A Practical Handbook, Stata Press, 2010
- | Rossak I & Hanser C: Datenintegration: Integrationsansätze, Beispielszenarien, Problemlösungen, Talend Open Studio, 2013
- | Thome G & Solbach W: Grundlagen und Modelle des Information Lifecycle Management, Xpert.press, 2007

## Constructive Alignment

Beginning with the problem to guarantee the quality of the provided raw data in an application context, the students develop the necessary know-how in the field of data management. Starting with collecting the knowledge distributed amongst the team members, the students recognize and closed knowledge gaps by researching and exercising in their respective groups. This module is accompanied by classes providing an introduction to data management methods. The students proof their gain in competences in a project work as well as a final presentation.

### SRH University Heidelberg, M. Sc. part-time program Big Data & Business Analytics

#### Module 3042 – Analytics I

Semester	Annually offered	Duration (weeks)	Type	ECTS points	Student's workload (1 ECTS appropriates 25 h; For exceptions view appendix 2b of the examination regulations)
1	2x	5	Compulsory module	6	<ul style="list-style-type: none"> <li>- 150 hours, thereof:</li> <li>- 30 in class,</li> <li>- 105 private studies,</li> <li>- 15 coaching</li> </ul>
Requirements for enrolment	Applicability	Type(s) of exam	Teaching and learning methods	Module coordinator	
none	Case Studies	Written exam	<ul style="list-style-type: none"> <li>- Individual work</li> <li>- Team work</li> <li>- Exercises</li> <li>- Lecture</li> </ul>	Prof. Dr. Herbert Schuster	

#### Learning objectives

#### Abstract:

During this module the students learn the essential tools and methods of inductive and descriptive statistics. They are able to perform first analyses individually using standard tools (SAS, SPSS, etc.). Hereby the students understand the applicability, prerequisites and the interpretation purposes of the diverse statistical methods

taught during this module.

Learning outcomes Specialist competence:

- | The students are able to use the relevant statistical concepts and methods adequately. They understand methods in context of their function and are capable to use them in a problem-solving manner.
- | They may execute more complex analyses and understand to evaluate the gained results analytically.
- | They are capable to adapt their gained knowledge and competence to solve new, unknown projects in an objective-oriented manner.

Learning outcomes Method competence

- | The students are able to apply their theoretical competences practically on selected software systems.
- | They may evaluate the adequate usage of these competences.

Learning outcomes Social and personal competence:

- | The students are capable to analyze and classify problems individually as well as in teams and may develop user-centered solutions based on the analysis and classification results.

## Course content

### Course content catering the aforementioned competences:

#### Descriptive statistics

- | Introduction of key concepts of logic and statistics
- | Principles of statistics
- | Classification of variables
- | Measure of central tendency
- | Dispersion parameters
- | Simple and multiple regression and correlation analysis
- | Modelling concepts
- | Cluster processes

#### Inductive statistics

- | Introduction of combinatorics
- | Principles of the theory of probabilities
- | Theoretical distributions
- | Theory of sampling and estimation methods

All chapter are taught in a methodologically-theoretically as well in application-oriented manner. Therefore problems, on which the introduced methods specifically could be applied, as well as a complete application are used.

### Recommended literature for preparation and follow-up:

- | Bamberg G & Baur F: Statistik, 12. Auflage, Oldenbourg, München/Wien, 2006.
- | Fahrmeir L *et al.*: Statistik: Der Weg zur Datenanalyse, 7. Auflage, Springer, Berlin, 2010
- | Handl A: Multivariate Analysemethoden: Theorie und Praxis multivariater Verfahren unter besonderer Berücksichtigung von S-Plus, 2. Auflage, Springer, Berlin, 2010.
- | Hartung J: Statistik - Lehr- und Handbuch der angewandten Statistik, 14. Auflage, Oldenbourg Verlag, München, 2005.
- | Mosler K & Schmid F: Beschreibende Statistik und Wirtschaftsstatistik, 4. Auflage, Springer Verlag, Heidelberg, 2009
- | Schlittgen R: Multivariate Statistik, Oldenbourg, München/Wien, 2009.

Constructive Alignment

The students are examined using a written examination. Through this examination form the evaluation of the basic vocabulary as well as the application of the theoretical principles on well-defined scenarios. Another objective of this examination is the transfer of the principles learned on new, complex problems.

**SRH University Heidelberg, M. Sc. part-time program Big Data & Business Analytics**

Module 3043 – Analytics II

Semester	Annually offered	Duration (weeks)	Type	ECTS points	Student's workload (1 ECTS appropriates 25 h; for exceptions view appendix 2b of the examination regulations)
2	2x	5	Compulsory module	6	<ul style="list-style-type: none"> <li>- 150 hours, thereof:</li> <li>- 30 in class</li> <li>- 105 private studies,</li> <li>- 15 coaching</li> </ul>
Requirements for enrolment	Applicability	Type(s) of exam	Teaching and learning methods	Module coordinator	
- Analytics I	<ul style="list-style-type: none"> <li>- In the case studies</li> <li>- Master thesis project</li> </ul>	<ul style="list-style-type: none"> <li>- Oral examination</li> <li>- Test</li> </ul>	<ul style="list-style-type: none"> <li>- Problem-oriented work</li> <li>- Seminar</li> <li>- Exercises</li> </ul>	Prof. Dr. Herbert Schuster	

Learning objectives

Abstract:

The students know the challenges posed by Big data on the structured data acquisition and their processing into information being helpful for making business-relevant decisions. They are capable of structuring complex problems and performing systematic research work. Based on huge data amounts they may analyse and prepare information to generate user-centered knowledge. They are able to select the adequate data mining techniques to solve specific business-relevant problems and to visualize the gained results appropriately. Finally the results are evaluated critically regarding their validity.

Learning outcomes Specialist competence:

- | The students know the essential methods for the procedural steps of the preparation of data mining methods: preparation of raw data, structuring and refining.
- | They are capable to perform and apply the most important methods of context analyses
- | They are able to perform more complex analyses and to evaluate the results in a functional way.
- | They may critically reflect the validity of the results regarding qualitative as well as quantitative aspects.
- | They know the most important web mining tools and are capable to apply them in relevant practical exercises.
- | They identify state of the art concept to visualize data mining results.

Learning outcomes Method competence:

- | The students may apply correctly the introduced methods by solving specific problems and interpreting the results adequately.
- | They know the most essential methods in data mining analysis.
- | They are able to apply the methods learned by using specific software solutions and may critically reflect the result's validity.

Learning outcomes Social and personal competence

- | The students are capable to analyze the methods used as well as the results gained in their entity and evaluate them benefit-oriented during a business-specific decision-making process.

## Course content

### Course content catering the aforementioned competences:

- | Introduction of data mining methods
- | Data mining as a process
- | Methods 1: Decision trees
- | Methods 2: Association rules and sequence patterns
- | Methods 3: Classification theories
- | Methods 4: Variance analysis, factor analysis, discriminant analysis
- | Methods 5: time series analysis

All methods are applied on defined examples via the use of standard analysis systems.

### Recommended literature for preparation and follow-up:

- | Dorschel J: Praxishandbuch Big Data. Wirtschaft-Recht-Technik, Springer Gabler, Heidelberg, 2015.
- | Ester, M & Sander J: Knowledge Discovery in Databases. Techniken und Anwendungen. Springer, Berlin 2000.
- | Ferber R: Information Retrieval. Suchmodelle und Data Mining - Verfahren für Textsammlungen und das Web, dpunkt.verlag, Heidelberg, 2003.
- | Fischer P: Algorithmisches Lernen, B.G. Teubner, Stuttgart, 1999
- | Han J *et al.*: Data Mining: Concepts and Techniques, Elsevier/Morgan Kaufmann, Amsterdam, 2006.
- | Hand D. *et l.*: Principles of Data Mining, MIT Press, Cambridge (Mass.)/London, 2001.
- | Kantardzic M: Data Mining, Wiley, 2011.
- | Liu B: Web Data Mining: Exploring Hyperlinks, Contents and Usage Data (Data-Centric Systems and Applications, 2. Auflage, Springer, 2011.
- | Marsland S: Machine Learning - An Algorithmic Perspective, CRC Press, 2009.
- | Mitchell TM: Machine Learning, McGraw-Hill, 1997.
- | Runkler TA: Data Mining - Methoden und Algorithmen intelligenter Datenanalyse, Springer Vieweg, 2010.
- | Schwarz T: Big Data im Marketing: Chancen und Möglichkeiten für eine effektive Kundenansprache, Haufe-Lexware, 2015.
- | Witten IH *et al.*: Data Mining: Practical Machine Learning, Tools and Techniques, 3<sup>rd</sup> edition, Elsevier, 2011.

## Constructive Alignment

The students proof their application-oriented knowledge and competences by solving well-defined problems and exercises during an oral examination. This form of examination also evaluates the student's interpretation capabilities.

**SRH University Heidelberg, M. Sc. part-time program Big Data & Business Analytics**

Module 3044 – Analytics III

Semester	Annually offered	Duration (weeks)	Type	ECTS points	Workload (1 ECTS appropriates 25 h; For exceptions view appendix 2b of the examination regulations)
3	2x	10	Compulsory module	6	<ul style="list-style-type: none"> <li>- 150 hours, thereof:</li> <li>- 30 in class,</li> <li>- 105 private studies,</li> <li>- 15 coaching</li> </ul>
Requirements for enrolment	Applicability	Type(s) of exam	Teaching and learning methods	Module coordinator	
- Analytics I	<ul style="list-style-type: none"> <li>- In the case studies</li> <li>- M. Sc. project</li> </ul>	<ul style="list-style-type: none"> <li>- Oral examination</li> <li>- Test</li> </ul>	<ul style="list-style-type: none"> <li>- Problem-oriented learning</li> <li>- Seminar</li> <li>- Exercises</li> </ul>	Prof. Dr. Herbert Schuster	

Learning objectives

Abstract:

During this module the students learn the key methods of predictive analytics and are capable of using the common standard tools (e.g. SAS, SPSS, BO, IBM Operation Analytics) to perform analyses independently and critically evaluate the results in terms of validity and adequate use. They are able to apply their gained competences in new, complex situations in an objective-oriented manner.

Learning outcomes Specialist competence:

- | The students are able to use the functional terms learned during this module adequately as well as applying the methods in a practice-oriented way.
- | They are able to perform more complex analyses and evaluate the results in a functional way.
- | They may critically reflect the validity of the results regarding qualitative as well as quantitative aspects.

Learning outcomes Method competence:

| They are able to apply the methods learned by using specific software solutions and may critically reflect the result's validity.

Learning outcomes Social and personal competence:

| The students are capable to analyze and classify problems individually as well as in teams and may develop user-centered solutions based on the analysis and classification results.

Course content

Course content catering the aforementioned competences:

Analytics III is a practice-oriented module, which is based on the SAS course „Advanced Analysis in a Big Data World, HAW Predictive Analytics and Social Media Analytics“. The module is held in cooperation with SAS.

- | Neuronal networks
- | Support Vector Machines
- | Opening of Black Box for neuronal networks and SVMs
- | Regression trees
- | Ensemble methods
- | Rule types and alternative rule descriptions
- | Bayes network classifier
- | Survival time analysis
- | Social Networks: Learning and interference
- | Surveillance and back testing of analytical methods

Recommended literature for preparation and follow-up:

- | Dorschel J: Praxishandbuch Big Data. Wirtschaft-Recht-Technik, Springer Gabler, Heidelberg, 2015.
- | Ester, M & Sander J: Knowledge Discovery in Databases. Techniken und Anwendungen. Springer, Berlin 2000.
- | Ferber R: Information Retrieval. Suchmodelle und Data Mining - Verfahren für Textsammlungen und das Web, dpunkt.verlag, Heidelberg, 2003.
- | Fischer P: Algorithmisches Lernen, B.G. Teubner, Stuttgart, 1999
- | Han J *et al.*: Data Mining: Concepts and Techniques, Elsevier/Morgan Kaufmann, Amsterdam, 2006.
- | Hand D. *et al.*: Principles of Data Mining, MIT Press, Cambridge (Mass.)/London, 2001.
- | Kantardzic M: Data Mining, Wiley, 2011.
- | Liu B: Web Data Mining: Exploring Hyperlinks, Contents and Usage Data (Data-Centric Systems and Applications, 2. Auflage, Springer, 2011.
- | Marsland S: Machine Learning - An Algorithmic Perspective, CRC Press, 2009.
- | Mitchell TM: Machine Learning, McGraw-Hill, 1997.

- | Runkler TA: Data Mining - Methoden und Algorithmen intelligenter Datenanalyse, Springer Vieweg, 2010.
- | Schwarz T: Big Data im Marketing: Chancen und Möglichkeiten für eine effektive Kundenansprache, Haufe-Lexware, 2015.
- | Witten IH *et al.*: Data Mining : Practical Machine Learning, Tools and Techniques, 3<sup>rd</sup> edition, Elsevier, 2011.

Constructive Alignment

The students proof their application-oriented knowledge and competences by solving well-defined problems and exercises during an oral examination. This form of examination also evaluates the student's interpretation capabilities.

**SRH University Heidelberg, M. Sc. part-time program Big Data & Business Analytics**

Module 3045 – Data Storytelling and Communication

Semester	Annually offered	Duration (weeks)	Type	ECTS points	Student's workload (1 ECTS appropriates 25 h; for exceptions view appendix 2b of the examination regulations)
1,2,3	2x	20	Compulsory module	12	<ul style="list-style-type: none"> <li>- 300 hours, thereof:</li> <li>- 60 in class,</li> <li>- 210 private studies,</li> <li>- 30 coaching</li> </ul>

Requirements for enrolment	Applicability	Type(s) of exam	Teaching and learning methods	Module coordinator
none	<ul style="list-style-type: none"> <li>- In case studies</li> <li>- M. Sc. project</li> </ul>	<ul style="list-style-type: none"> <li>- Portfolio exam</li> <li>- Presentation</li> </ul>	<ul style="list-style-type: none"> <li>- Seminar</li> <li>- Lecture</li> <li>- Exercises</li> <li>- Team work</li> </ul>	N.N.

Learning objectives

Abstract:

The module "Data Storytelling and Communication" considers effective communication of insights regarding

the original problem. These insights are often described using dashboards, infographics, etc. The skills required for this are introduced during the courses held during the first and second semester. Information has to be interpreted, set in context with the original problem and analyzed data as well as to be deduced into insights, so that businesses may benefit from these visualizations and develop further actions. It is necessary to tell a "Data story" based on the original problem, reaching from data choice and analysis to insights and insight-derived actions. A central aspect of data storytelling is to communicate insights appropriate to the target group.

This module introduces the principles of traditional storytelling as well as those of data-driven storytelling.

Learning outcomes Specialist competence:

- | The students are able to use data visualizations for interactive storytelling enabling and supporting the exploration of analysis results as well as the derivation of new problems.
- | They may visualize and communicate analysis results in a target group-oriented way.

Learning outcomes Method competence:

- | After completion of this module the students know tools supporting interactive storytelling (e.g. GeoTime Stories, Tableau Public) and are able to use them in a target-oriented manner.
- | They are capable to prepare insights according to their target group and decisions regarding the original problem

Learning outcomes Social competence:

- | They improve their communication abilities
- | They are capable of recognizing the needs of a target group so that they prepare information and communicate insights properly.

Learning outcomes Personal competence:

## Course content

### Course content catering the aforementioned competences:

- | Theories of story setup, structures and intentions
- | Explorative data analysis
- | Effectively written communication
- | Effectively visual presentations
- | Design principles (Forms, colors, etc.)
- | Human perception
- | Story development and compaction
- | Interplay between narrative and visual communication
- | interactive Storytelling
- | Infographics, dashboards, etc.
- | Tools: Tableau, Illustrator, R/ggplot, Photoshop, GeoTime Stories, Tableau Public

### Recommended literature for preparation and follow-up:

- | Alexander B: The New Digital Storytelling: Creating Narratives with New Media, ABC-Clio, 2011.
- | Berinato S: Good Charts: The HBR Guide to Making Smarter, More Persuasive Data Visualizations, Harvard Business Review Press, 2016.
- | DeBarros A: Practical SQL: A Beginner's Guide to Storytelling with Data, No Starch Press, 2018.
- | Evergreen SDH: Effective Data Visualization: The Right Chart for the Right Data, Sage Pubn, 2016.
- | Foreman JW: Data Smart: Using Data Science to Transform Information into Insight, 1<sup>st</sup> edition, Wiley, 2013.
- | Marr B: Big Data: Using SMART Big Data, Analytics and Metrics to Make Better Decisions and Improve Performance, 1<sup>st</sup> edition, Wiley, 2015.
- | Nussbaumer Knaflic C: Storytelling mit Daten. Die Grundlagen der effektiven Kommunikation und Visualisierung mit Daten, 1. Auflage, Vahlen, 2017.
- | Provost F & Fawcett T: Data Science for Business: What you need to know about data mining and data-analytic thinking, 1<sup>st</sup> edition, O'Reilly, 2013.
- | Wong DM: The Wall Street Journal Guide to Information Graphics: The Dos and Don'ts of Presenting Data, Facts, and Figures, Reprint-Auflage, Ww Norton & Co, 2014.

### Constructive Alignment

The students analyze different story examples and subsequently develop own stories based on role-plays. The methodological spectrum thereby reaches from data selection and visualization to interpretations for different target groups. This work is performed individually as well as in teams. Finally the students or their respective groups present their developed stories to each other and subsequently critically reflect the results. The combined examination form consisting of presentation and portfolio suit the module intention adequately because there is a continuous documentation and evaluation of the students' improvements in competences as well as of the status of the data story..

## SRH University Heidelberg, M. Sc. part-time program Big Data & Business Analytics

### Module 3049 – Privacy, Ethics and International Law

Semester	Annually offered	Duration (weeks)	Type	ECTS points	Student's workload (1 ECTS appropriates 25 h; For exceptions view appendix 2b of the examination regulations)
2,4	2x	10	Compulsory module	7	<ul style="list-style-type: none"> <li>- 175 hours, thereof:</li> <li>- 35 in class,</li> <li>- 122,5 private studies</li> <li>- 17,5 coaching</li> </ul>
Requirements for enrolment	Applicability	Type(s) of exam	Teaching and learning methods	Module coordinator	
none		<ul style="list-style-type: none"> <li>- Written exam</li> <li>- Exposé</li> </ul>	<ul style="list-style-type: none"> <li>- Problem-oriented learning</li> <li>- Seminar</li> <li>- Colloquium</li> </ul>	Prof. Dr. Anke Schuster	

### Learning objectives

Abstract:

During this module the students develop fundamental knowledge about privacy, ethics and the judicial aspects in context of data analysis. They generate an awareness of ethically relevant problems and they are able to

evaluate individual, social and institutional actions in socio-technical situations (e.g. based on privacy law). Additionally, they learn to impose privacy requirements through organizational-technical measures.

This module comprises two courses: "Privacy and its realization" during the second and "Ethics and Law" during the fourth semester.

Learning outcomes Specialist competence:

- | The students are able to examine contexts of origin and effects from an ethical perspective and may apply ethical and privacy concepts on defined examples of socio-technical scenarios.
- | They know the prerequisites of a transparent, informed approval as well as the prerequisites of data transfer and may derive consequences for big data projects.
- | They are capable of reproducing and applying the principles of data curation and utilization according to national and international law
- | They know and exert the relevant privacy laws, regulations and strategies.

Learning outcomes Method competence:

- | The students know and target-orientedly apply organizational as well as technical measures to impose privacy and personal rights

Learning outcomes Social and personal competence:

- | The students may analyze and evaluate well-defined problems independently.
- | They are able to discuss in a functional and scientific way.

Course content

Course content catering the aforementioned competences:

*Ethics and international law*

- | Terminology of ethics, business ethics
- | Ethics within the technical civilization/occupations
- | Individual and institutional ethics
- | Ethical codices for computer scientists
- | Ethics within an interconnected world
- | Lawful actions and conflict of interests
- | Rights of the persons affected
- | International data processing and jurisdiction
- | Principles of appropriation and approval requirements

- | Regimentation in big data inquiries
- | Contracts regarding data and data analyses
- | German privacy, internet and communication laws (Bundesdatenschutzgesetz, Telemediengesetz, Telekommunikationsgesetz)
- | Data transfer within a business and places outside the EU

#### *Privacy and its enforcement*

- | Principles of privacy law
- | Data separation
- | Technologies to enforce privacy requirements
- | Organizational measures
- | Anonymization and pseudonymization
- | Application scenarios
- | Risks caused by data aggregation
- | Misuse of data

#### Recommended literature for preparation and follow-up:

- | Bachmann R *et al.*: Big Data - Fluch oder Segen? Unternehmen im Spiegel gesellschaftlichen Wandels, mitp Press, 2014.
- | Dorschel J: Praxishandbuch Big Data: Wirtschaft-Recht-Technik, Springer-Gabler, Heidelberg, 2015
- | Gola P & Reif Y: Praxisfälle Datenschutzrecht, 1.A., Heidelberg, 2013
- | Grunwald A: Technikfolgenabschätzung, 2. Auflage, Berlin, 2010.
- | Hausmanninger T & Capurro R: Netzethik. Grundlegungsfragen der Internetethik, München, 2002.
- | Kuhlen R: Informationsethik, Konstanz, 2004.
- | Lenk H & Ropohl G: Technik und Ethik, Stuttgart, 1993.
- | Richter P: Privatheit, Öffentlichkeit und demokratische Willensbildung in Zeichen von Big Data, Nomos, Baden-Baden, 2015
- | Stamatellos, G: Computer Ethics. A global perspective, Sudbury, 2007.
- | Stoecker R *et al.*: Handbuch Angewandte Ethik, Stuttgart, 2011.
- | Taeger J: Einführung in das Datenschutzrecht, 1.A., Heidelberg, 2013.
- | Worms N: Informationsethik und Online-Netzwerke: Im Spannungsfeld zwischen struktureller Bedingtheit und Privatsphäre, 1.A., Berlin, 2010.

## Constructive Alignment

During the course "Ethics and law" the students learn, analyze and discuss ethical and judicial aspects in context of big data and data analysis through well-defined practical examples as well as presentations. The gained theoretical competences in the actual privacy laws and regimentations are evaluated through a written examination. This form of examination additionally enables the students to reproduce, apply and discuss judicial aspects of privacy law on well-defined examples and scenarios.

The course "Privacy and its enforcement" enables the students to develop technical and organizational measures to enforce privacy and personality laws in big data projects and data analyses. The evaluation of the student's competence is performed via case work.

### SRH University Heidelberg, M. Sc. part-time program Big Data & Business Analytics

#### Module A-1003 – Master Thesis Project

Semester	Annually offered	Duration (weeks)	Type	ECTS points	Workload (1 ECTS appropriates 25 h; for exceptions view appendix 2b of the examination regulations)
4	2x	20	Compulsory module	18	<ul style="list-style-type: none"> <li>- 450 hours, thereof:</li> <li>- 0 in class,</li> <li>- 405 private studies,</li> <li>- 45 coaching</li> </ul>
Requirements for enrolment	Applicability	Type(s) of exam	Teaching and learning methods	Module coordinator	
Scientific work and ethics		- Project work	<ul style="list-style-type: none"> <li>- Problem-oriented learning</li> <li>- Data research, analysis and processing</li> </ul>	N.N.	

## Learning objectives

### Abstract:

The students understand the fundamental aspects of scientific work and are able to structure and exert individually the cognitive process from the original problem to the systematic answering of a well-defined scientific problem. They know the essential methods and tools for the development of a scientific work and may critically reflect the results. They are capable of a qualitative as well as quantitative evaluation of method use. The students may work independently on a scientific big data and business analytics problem using common scientific methods and gain new insights.

### Learning outcomes Specialist and method competence:

- | The students are able to structure their scientific cognitive process. They yield results according to the criteria of good scientific work (i.e. objectivity, validity and reliability)
- | They are capable of giving proper qualitative as well as quantitative judgements regarding the adequate use of scientific methods
- | They may critically evaluate and reflect the gained results and method.
- | They intensify functional and scientific-methodological competences learned during the master program over the defined problem of the master thesis project.
- | They are able to transfer the knowledge of "Scientific work and ethics" on the master thesis project.
- | They are competent to lead and moderate a functional scientific discussion to analytically-critically reflect scientific results and use of methods.

### Learning outcomes Social competence:

- | The students are able to evaluate results, gain in insights on a functional basis and may verbalize constructive feedback.
- | They are capable of leading a functional discussion to gain insights.

### Learning outcomes Personal competence:

- | The students are able to perform research work systematically and independently as well as to reflect insights using iterative thinking processes.
- | They are competent to structure the scientific cognitive process of the master thesis project regarding scheduling, systematic structuring and gaining of insights.

## Course content

### Course content catering the aforementioned competences:

#### Scientific work and writing

- | Scientific quality criteria
- | Scientific methods
- | Criteria to evaluate scientific works
- | Research, classification and evaluation of scientific literature
- | Scientific writing
- | Leading and moderation of scientific discussions

### Recommended literature for preparation and follow-up:

- | Balzert H, Schäfer C, Schröder M, Kern U: Wissenschaftliches Arbeiten, W3L GmbH, 2008
- | Franck N, Stary J: Die Technik wissenschaftlichen Arbeitens, UTB,. 2009.
- | Karmasin M, Ribing R: Die Gestaltung wissenschaftlicher Arbeiten: Ein Leitfadens für Seminararbeiten, Bachelor-, Master- und Magisterarbeiten sowie Dissertationen, UTB, 2012
- | Oehrich M: Wissenschaftliches Arbeiten und Schreiben. Schritt für Schritt zur Bachelor- und Master-Thesis in den Wirtschaftswissenschaften, Springer Gabler, Heidelberg, 2015
- | Theisen MR: Wissenschaftliches Arbeiten: Erfolgreich bei Bachelor- und Masterarbeiten, Vahlen, 2013

#### Links

- | Google Scholar
- | DBLP
- | IEEE Computer Society
- | IEEE TVCG camera ready document guidelines

#### Literature management

- | Citavi

## Constructive Alignment

Module is completed by the master thesis project work.