

C>ONSTRUCTOR
UNIVERSITY



**Study
Program
Handbook**

Management, Decisions and Data Analytics

Bachelor of Science

Subject-specific Examination Regulations for Management, Decisions and Data Analytics (Fachspezifische Prüfungsordnung)

The subject-specific examination regulations for Management, Decisions and Data Analytics are defined by this program handbook and are valid only in combination with the General Examination Regulations for Undergraduate degree programs (General Examination Regulations = Rahmenprüfungsordnung). This handbook also contains the program-specific Study and Examination Plan (Chapter 5).

Upon graduation, students in this program will receive a Bachelor of Science (BSc) degree with a scope of 180 ECTS (for specifics see Chapter 3 of this handbook).

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1 Program Overview

1.1 Concept

1.1.1 The Constructor University Educational Concept

Constructor University aims to educate students for both an academic and a professional career by emphasizing three core objectives: academic excellence, personal development, and employability to succeed in the working world. Constructor University offers an excellent research driven education experience across disciplines to prepare students for graduate education as well as career success by combining disciplinary depth and interdisciplinary breadth with supplemental skills education and extra-curricular elements. Through a multi-disciplinary, wholistic approach and exposure to cutting-edge technologies and challenges, Constructor University develops and enables the academic excellence, intellectual competences, societal engagement, professional and scientific skills of tomorrow's leaders for a sustainable and peaceful future.

In this context, it is Constructor University's aim to educate talented young people from all over the world, regardless of nationality, religion, and material circumstances, to become citizens of the world who are able to take responsible roles for the democratic, peaceful, and sustainable development of the societies in which they live. This is achieved through a high-quality teaching as well as manageable study loads and supportive study conditions. Study programs and related study abroad programs convey academic knowledge as well as the ability to interact positively with other individuals and groups in culturally diverse environments. The ability to succeed in the working world is a core objective for all study programs at Constructor University, both in terms of actual disciplinary subject matter and also to the social skills and intercultural competence. Study-program-specific modules and additional specializations provide the necessary depth, interdisciplinary offerings provide breadth while the university-wide general foundation and methods modules, optional German language and Humanities modules, and an extended internship period strengthen the employability of students. The concept of living and learning together on an international campus with many cultural and social activities supplements students' education. In addition, Constructor University offers professional advising and counseling.

Constructor University's educational concept is highly regarded both nationally and internationally. While the university has consistently achieved top marks over the last decade in Germany's most comprehensive and detailed university ranking by the Center for Higher Education (CHE), it has also been listed by the renowned Times Higher Education (THE) magazine as one of the top 300 universities worldwide (ranking group 251-300) in 2019 as well as in 2021. Since 2022 Constructor University is considered to be among the top 30 percent out of more than 1600 universities worldwide and is ranked the most international university in Germany. The THE ranking is considered as one of the most widely observed university rankings. It is based on five major indicators: research, teaching, research impact, international orientation, and the volume of research income from industry.

1.1.2 Program Concept

The BSc Management, Decisions and Data Analytics (MDDA) program's mission is to prepare students for their professional occupations in a globalized world, driven by a need to create

value from an abundance of data. Nowadays, companies of any size, ranging from highly innovative start-ups to large multinational-enterprises, have access to multiple data sources and face immense competitive pressure to utilize this data for their operational and strategic decision-making. To succeed in this environment, managers need to develop not only managerial skills but have to extend their knowledge to fields such as machine learning and data analytics. But ultimately, value creation out of data also encompasses a deep understanding of how humans – with their behavior captured in data – form decisions. The Management, Decisions and Data Analytics program is designed for young scholars from all over the world who share an interest in business activities, management and entrepreneurship in a data-driven context.

The program prepares students to solve management and business problems by applying methods such as machine learning, big data analytics and data visualization in the process of decision making. It addresses key managerial and methodological skills for the next generation of young professionals in times of digital transformation.

The three years BSc program is structured around three main pillars: (1) Management, (2) Decision Making and (3) Data Analytics. In the first year, students will focus on the foundations of these three pillars. The second year is dedicated to business courses aiming at the digital transformation and entrepreneurship. In the Decision Making pillar, students will deepen their understanding of the decision-making processes, both for individuals and within organizations. The third part of the second year comprises data analytics and machine learning. In the third year, tailor-made specialization courses will combine the three pillars in a holistic way by focusing on subjects such as use of data in Marketing. In their sixth semester, the students will work on their Bachelor Thesis. Moreover, the students will do a mandatory internship between the second and third year.

To expose students to relevant theories, to their application and to the latest scientific methods in this field, the program applies a combination of lectures, seminars, and case studies and fosters an informed, comparative, and critical understanding of common business practices, problems, and values in a data-driven context.

1.2 Specific Advantages of the MDDA Program at Constructor University

Right from the start, the Management, Decisions and Data Analytics program exposes students to the challenges of data-driven businesses. Challenging case studies of real companies require students to develop creative solutions in intercultural teams. Working in small teams to tackle these challenges is an integral part of the study program. With its diverse and international student body and its strength in cutting-edge research on computer science, management, psychology and data analytics, Constructor University provides an ideal environment to study Management, Decisions and Data Analytics. Already in the classroom students are exposed to transnational and culturally diverse teams and topics from a variety of industries. This intense exposure to real challenges of data-driven companies combined with highly international and diverse student teams is a unique advantage of the Management, Decisions and Data Analytics program at Constructor University. The unique combination of business, technology and methodology will provide students with a competitive edge in the job market and advance into a future-oriented career in a global company or innovative start-up. Likewise, the study program qualifies students to continue their studies in international graduate schools.

1.3 Program-specific Educational Aims

1.3.1 Qualification Aims

The Management, Decisions and Data Analytics study program awards a Bachelor of Science degree.

This program aims to prepare young talents for careers in management within a data-driven economy and teaches them to apply data in managerial decision processes and to create value from data. The program covers key frameworks in management and decision making, paired with the concepts and tools necessary to process and analyze data within the corporate context. Furthermore, the students will apply these skills in multinational groups to analyze and evaluate real-world challenges and to create professional solutions to these challenges.

The scientific education provided by the program focuses on quantitative techniques and coursework.

1.3.2 Intended Learning Outcomes

By the end of the program, students will be able to:

1. understand and analyze the important issues that influence the choice of business strategy in a data-driven economy;
2. develop practical knowledge and management skills for digital transformation;
3. describe the major models and theories of behavioral decision making;
4. discuss applications of decision-making research in business;
5. apply and evaluate social cognitive and social influence theories to explain or predict real-world phenomena;
6. apply fundamental data science methods to structured data and use state-of-the-art tools to prepare and process unstructured data;
7. identify and evaluate important problem types and solution approaches in data analytics;
8. transform theoretical knowledge from management, decision making and data analytics into creative approaches while solving real-world problems;
9. use academic or scientific methods as appropriate in the field of MDDA such as defining research questions, justifying methods, collecting, assessing and interpreting relevant information, and drawing scientifically-founded conclusions that consider social, scientific and ethical insights;
10. develop and advance solutions to problems and arguments in their subject area and defend these in discussions with specialists and non-specialists;
11. engage ethically with academic, professional and wider communities and to actively contribute to a sustainable future, reflecting and respecting different views;
12. take responsibility for their own learning, personal and professional development and role in society, evaluating critical feedback and self-analysis;
13. apply their knowledge and understanding to a professional context;
14. take on responsibility in a diverse team;
15. adhere to and defend ethical, scientific and professional standards.

1.4 Career Options

The BSc Management, Decisions and Data Analytics program is centered around the ever-increasing need for managers being able to understand and use data in a business setting. The unique combination of business, technology and methodology will provide students with a competitive edge in the job market and advance into a future-oriented career in a global company or innovative start-up. Likewise, the study program qualifies students to continue their studies in international graduate schools.

The Student Career Support (SCS) as well as the Constructor University Alumni Office help students in their career development. The SCS provides students with high quality training and coaching in CV creation, cover letter formulation, interview preparation, effective presenting, business etiquette and employer research as well as in many other aspects, thus helping students identify and follow up rewarding careers after their time at Constructor University. Furthermore, the Alumni Office helps students establish a long-lasting and worldwide network which comes in handy when exploring job options in academia, industry, and elsewhere.

1.5 Admission Requirements

Admission to Constructor University is selective and based on a candidate's school and/or university achievements, recommendations, self-presentation, and performance on standardized tests. Students admitted to Constructor University demonstrate exceptional academic achievements, intellectual creativity, and the desire and motivation to make a difference in the world.

The following documents need to be submitted with the application:

- Recommendation Letter (optional)
- Official or certified copies of high school/university transcripts
- Educational History Form
- Standardized test results (SAT/ACT) if applicable
- Motivation statement
- ZeeMee electronic resume (optional)
- Language proficiency test results (TOEFL Score: 90, IELTS: Level 6.5 or equivalent)

Formal admission requirements are subject to higher education law and are outlined in the Admission and Enrollment Policy of Constructor University.

For more detailed information about the admission visit:

<https://constructor.university/admission-aid/application-information-undergraduate>

1.6 More Information and Contact

For more information, please contact the study program chair:

Prof. Dr. Sven Voelpel

Professor of Business Administration

E-mail: svoelpel@constructor.university

Telephone: +49 421 200 3467

Or visit our website: <https://www.jacobs-university.de/directory/svoelpel>

2 The Curricular Structure

2.1 General

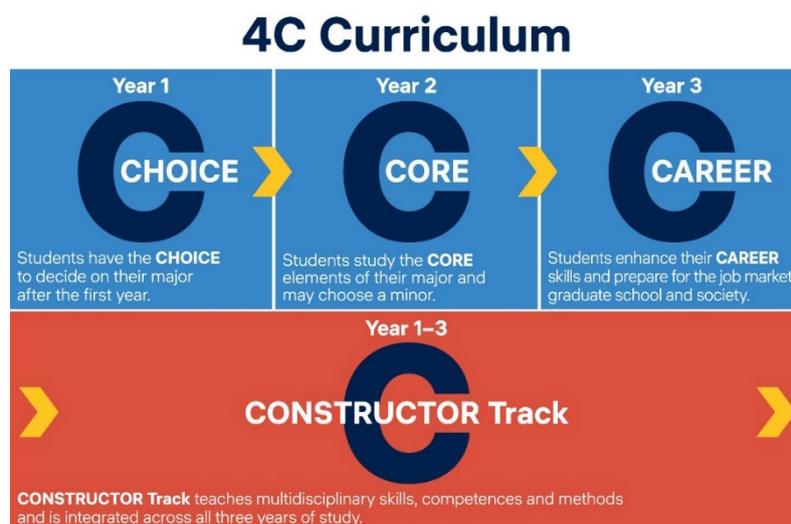
The curricular structure provides multiple elements for enhancing employability, interdisciplinarity, and internationality. The unique CONSTRUCTOR Track, offered across all undergraduate study programs, provides comprehensive tailor-made modules designed to achieve and foster career competency. Additionally, a mandatory internship of at least two months after the second year of study and the possibility to study abroad for one semester give students opportunities to gain insight into the professional world, apply their intercultural competences and reflect on their roles and ambitions for employment and in a globalized society.

All undergraduate programs at Constructor University are based on a coherently modularized structure, which provides students with an extensive and flexible choice of study plans to meet the educational aims of their major and complete their studies within the regular period.

The framework policies and procedures regulating undergraduate study programs at Constructor University can be found on the website (<https://constructor.university/student-life/student-services/university-policies>).

2.2 The Constructor University 4C Model

Constructor University offers study programs that comply with the regulations of the European Higher Education Area. All study programs are structured according to the European Credit Transfer System (ECTS), which facilitates credit transfer between academic institutions. The three-year undergraduate program involves six semesters of study with a total of 180 ECTS credit points (CP). The undergraduate curricular structure follows an innovative and student-centered modularization scheme - the 4C-Model. It groups the disciplinary content of the study program in three overarching themes, CHOICE-CORE-CAREER according to the year of study, while the university-wide CONSTRUCTOR Track is dedicated to multidisciplinary content, methods as well as intellectual skills and is integrated across all three years of study. The default module size is 5 CP, with smaller 2.5 CP modules being possible as justified exceptions, e.g., if the learning goals are more suitable for 2.5 CP and the overall student workload is balanced.



2.2.1 Year 1 – CHOICE

The first study year is characterized by offerings of disciplinary education that builds on and expands upon the students' entrance qualifications. Students select introductory modules for a total of 45 CP from the CHOICE area. The Academic Advising Coordinator offers curriculum counseling to all Bachelor students independently of their major, while Academic Advisors, in their capacity as contact persons from the faculty, support students individually in deciding on their major study program.

To pursue Management, Decisions and Data Analytics as a major, students take the following mandatory CHOICE modules (45 CP)

- CHOICE Module: Introduction to International Business (7.5 CP)
- CHOICE Module: Introduction to Finance and Accounting (7.5 CP)
- CHOICE Module: Essentials of Cognitive Psychology (7.5 CP)
- CHOICE Module: Essentials of Social Psychology (7.5 CP)
- CHOICE Module: Introduction to Data Science (7.5 CP)
- CHOICE Module: Data Structures and Processing (7.5 CP)

The combination of modules from all three pillars of the MDDA program allows students to develop a holistic understanding of the complex nature of data-driven businesses right from the start of their studies.

2.2.1.1 Major Change Option

Students can still change to another major at the beginning of their second year of studies, provided they have taken the corresponding mandatory CHOICE modules in their first year of studies. All students must participate in a seminar on the major change options in the O-Week and consult their Academic Advisor during the first year of studies prior to changing their major.

Students in the MDDA program can change their major after the first year to the ISCP program, which shares the following mandatory CHOICE modules.

- ISCP
CHOICE Module: Essentials of Cognitive Psychology (7.5 CP)
CHOICE Module: Essentials of Social Psychology (7.5 CP)

2.2.1.2 Minor Option

The Management, Decisions and Data Analytics students cannot take an additional minor as their study program already combines three different disciplines.

2.2.2 Year 2 – CORE

In their second year, students take a total of 45 CP from a selection of in-depth, discipline-specific CORE modules. Building on the introductory CHOICE modules and applying the methods and skills students have already acquired so far (see 2.3.1), these modules aim to expand the students' critical understanding of the key theories, principles, and methods in their major for the current state of knowledge and best practice.

To pursue MDDA as a major, all 45 CP from the following mandatory CORE modules need to be acquired:

- CORE Module: Digital Transformation and Information Economy (5 CP)
- CORE Module: Design Thinking, E-Business & E-Services (2.5 CP)
- CORE Module: Entrepreneurship and Innovation (7.5 CP)
- CORE Module: Social Cognition (5 CP)
- CORE Module: Organizational Psychology and Communication (5 CP)
- CORE Module: Judgment & Decision (5 CP)
- CORE Module: Data Analytics and Modeling (7.5 CP)
- CORE Module: Applied Machine Learning (7.5 CP)

2.2.3 Year 3 – CAREER

During their third year, students prepare for and make decisions about their career after graduation. To explore available choices fitting individual interests, and to gain professional experience, students take a mandatory summer internship (see 2.2.3.1). The third year of studies allows MDDA students to take Specialization modules within their discipline, but also focuses on the responsibility of students beyond their discipline (see CONSTRUCTOR Track).

The fifth semester also opens a mobility window for a diverse range of study abroad options. Finally, the sixth semester is dedicated to fostering the students' research experience by involving them in an extended Bachelor thesis project.

2.2.3.1 Internship / Start-up and Career Skills Module

As a core element of Constructor University's employability approach students are required to engage in a mandatory two-month internship of 15 CP that will usually be completed during the summer between the second and third years of study. This gives students the opportunity to gain first-hand practical experience in a professional environment, apply their knowledge and understanding in a professional context, reflect on the relevance of their major to employment and society, reflect on their own personal role in employment and society, and to develop a professional orientation. The internship can also establish valuable contacts for the students' bachelor's thesis project, for the selection of a master program graduate school or further employment after graduation. This module is complemented by career advising and several career skills workshops throughout all six semesters that prepare students for the transition from student life to professional life. As an alternative to the full-time internship, students interested in setting up their own company can apply for a start-up option to focus on developing their business plans.

For further information, please contact the Student Career Support (<https://constructor.university/student-life/career-services>).

2.2.3.2 Specialization Modules

In the third year of their studies, students take 15 CP from major-specific or major-related, advanced Specialization modules to consolidate their knowledge and to be exposed to state-of-the-art research in the areas of their interest. This curricular component is offered as a portfolio of modules, from which students can make free selections during their fifth and sixth semester.

The default specialization module size is 5 CP, with smaller 2.5 CP modules being possible as justified exceptions.

To pursue MDDA as a major, at least 15 CP from the following mandatory elective Specialization modules need to be taken:

- Specialization: Data Analytics (5 CP)
- Specialization: Contemporary Topics in Marketing (5 CP)
- Specialization: Advanced Econometrics (5 CP)
- Specialization: Financial Data Analytics (5 CP)

Please consult the *CampusNet* online catalogue for further options.

2.2.3.3 Study Abroad

Students have the opportunity to study abroad for a semester to extend their knowledge and abilities, broaden their horizons and reflect on their values and behavior in a different context as well as on their role in a global society. For a semester abroad (usually the fifth semester), modules related to the major with a workload equivalent to 22.5 CP must be completed. Modules recognized as study abroad CP need to be pre-approved according to Constructor University's study abroad procedures. Several exchange programs allow students to directly enroll at prestigious partner institutions worldwide. Constructor University's participation in Erasmus+, the European Union's exchange program, provides an exchange semester at a number of European universities that include Erasmus study abroad funding.

For further information, please contact the International Programs office (<https://constructor.university/student-life/study-abroad/international-office>).

MDDA students that wish to pursue a study abroad in their fifth semester are required to select their modules at the study abroad partners such that they can be used to substitute between 10-15 CP of major-specific Specialization modules and between 5-15 CP of modules equivalent to the non-disciplinary New Skills modules (see CONSTRUCTOR Track). In their sixth semester, according to the study plan, returning study-abroad students complete the Bachelor Thesis/Seminar module (see next section), they take any missing Specialization modules to reach the required 15 CP in this area, and they take any missing New Skills modules to reach the required 15 CP in this area.

2.2.3.4 Bachelor Thesis/Seminar Module

This module is a mandatory graduation requirement for all undergraduate students. It consists of two module components in the major study program guided by a Constructor University faculty member: the Bachelor Thesis (12 CP) and a Seminar (3 CP). The title of the thesis will appear on the students' transcripts.

Within this module, students apply the knowledge skills, and methods they have acquired in their major discipline to become acquainted with actual research topics, ranging from the identification of suitable (short-term) research projects, preparatory literature searches, the realization of discipline-specific research, and the documentation, discussion, and interpretation of the results.

With their Bachelor Thesis students demonstrate mastery of the contents and methods of their major-specific research field. Furthermore, students show the ability to analyze and solve a well-

defined problem with scientific approaches, a critical reflection of the status quo in scientific literature, and the original development of their own ideas. With the permission of a Constructor University faculty supervisor, the Bachelor Thesis can also have an interdisciplinary nature. In the seminar, students present and discuss their theses in a course environment and reflect on their theoretical or experimental approach and conduct. They learn to present their chosen research topics concisely and comprehensively in front of an audience and to explain their methods, solutions, and results to both specialists and non-specialists.

2.3 The CONSTRUCTOR Track

The CONSTRUCTOR Track is another important feature of Constructor University's educational model. The CONSTRUCTOR Track runs parallel to the disciplinary CHOICE, CORE, and CAREER modules across all study years and is an integral part of almost all undergraduate study programs. It reflects a university-wide commitment to help transform late-stage adolescents into confident, competent and responsible young adults by providing an intellectual tool kit to become life-long learners and by giving them the capacity to employ a range of methodologies to approach potential solutions to problems across disciplines. The CONSTRUCTOR Track contains Methods, New Skills and German Language / Humanities modules.

2.3.1 Methods Modules

Methods such as mathematics, statistics, programming, data handling, presentation skills, academic writing, and scientific and experimental skills are offered to all students as part of the Methods area in their curriculum. The modules that are specifically assigned to each study programs equip students with transferable academic skills. They convey and practice specific methods that are indispensable for each students' chosen study program. Students are required to take 20 CP in the Methods area. The size of all Methods modules is 5 CP.

To pursue MDDA as a major, the following Methods modules (20 CP) must be taken as mandatory modules:

- Methods Module: Applied Calculus (5 CP)
- Methods Module: Applied Statistics with R (5 CP)
- Methods Module: Marketing & Methods (5 CP)
- Methods Module: Econometrics (5 CP)

2.3.2 New Skills Modules

This part of the curriculum constitutes an intellectual and conceptual tool kit that cultivates the capacity for a particular set of intellectual dispositions including curiosity, imagination, critical thought, and transferability. It nurtures a range of individual and societal capacities, such as self-reflection, argumentation and communication. Finally, it introduces students to the normative aspects of inquiry and research, including the norms governing sourcing, sharing, withholding materials and research results as well as others governing the responsibilities of expertise as well as the professional point of view.

All students are required to take the following modules in their second year:

- New Skills Module: Logic (2.5 CP)

- New Skills Module: Causation and Correlation (2.5 CP)

These modules will be offered with two different perspectives of which the students can choose. The module perspectives are independent modules which examine the topic from different point of views. Please see the module description for more details.

In the third year, students take three 5 CP modules that build upon previous modules in the track and are partially constituted by modules that are more closely linked to each student's disciplinary field of study. The following module is mandatory for all students:

- New Skills Module: Argumentation, Data Visualization and Communication (5 CP)

This module will also be offered with two different perspectives of which the students can choose.

In their fifth semester, students may choose between:

- New Skills Module: Linear Model/Matrices (5 CP) and
- New Skills Module: Complex Problem Solving (5 CP).

The sixth semester also contains the choice between two modules, namely:

- New Skills Module: Agency, Leadership and Accountability (5 CP) and
- New Skills Module: Community Impact Project (5 CP).

Students who study abroad during the fifth semester and are not substituting the mandatory "Argumentation, Data Visualization and Communication" module, are required to take this module during their sixth semester. Students who remain on campus are free to take the Argumentation, Data Visualization and Communication module in either the fifth or sixth semester as they prefer.

2.3.3 German Language and Humanities Modules

German language abilities foster students' intercultural awareness and enhance their employability in their host country. They are also beneficial for securing mandatory internships (between the 2nd and 3rd year) in German companies and academic institutions. Constructor University supports its students in acquiring basic German skills in the first year of the CONSTRUCTOR Track. Non-native speaking students on campus are encouraged to take 2 introductory German modules (2.5 CP each), but are not obliged to do so. Native Germans as well as online students (and on campus students who decide against German) do have alternative modules in Humanities in each of the first two semesters:

- Humanities Module: Introduction to Philosophical Ethics (2.5 CP)
- Humanities Module: Introduction to the Philosophy of Science (2.5 CP)
- Humanities Module: Introduction to Visual Culture (2.5 CP)

2.4 Management, Decisions and Data Analytics as a minor

The Management, Decisions and Data Analytics study program does not offer a minor for students from other study programs.

3 MDDA Undergraduate Program Regulations

3.1 Scope of these Regulations

The regulations in this handbook are valid for all students who entered the Management, Decisions and Data Analytics undergraduate program at Constructor University in Fall 2023. In case of a conflict between the regulations in this handbook and the general Policies for Bachelor Studies, the latter apply (see <https://constructor.university/student-life/student-services/university-policies>).

In exceptional cases, certain necessary deviations from the regulations of this study handbook might occur during the course of study (e.g., change of the semester sequence, assessment type, or the teaching mode of courses).

In general, Constructor University Bremen reserves therefore the right to change or modify the regulations of the program handbook also after its publication at any time and in its sole discretion.

3.2 Degree

Upon successful completion of this study program, students are awarded a Bachelor of Science degree in Management, Decisions and Data Analytics.

3.3 Graduation Requirements

In order to graduate, students need to obtain 180 CP. In addition, the following graduation requirements apply:

Students need to complete all mandatory components of the program as indicated in the Study and Examination Plan in Chapter 5 of this handbook.

4 Schematic Study Plan for Management, Decisions and Data Analytics

Figure 1 shows schematically the sequence and types of modules required for the study program. A more detailed description, including the assessment types, is given in the Study and Examination Plans in the following section.

Management, Decisions and Data Analytics (180 CP)

Year 3**	Bachelor Thesis / Seminar (research or industry) (m, 15 CP)			Summer Internship/ Start-Up (after 2nd year) (m, 15 CP)	Argum./ Data Visual. Comm. *** (m, 5 CP)	Agency, Leadership & Accountability OR Community Impact Project (me, 5 CP)
	MDDA Specialization I (me, 5 CP)	MDDA Specialization II (me, 5 CP)	MDDA Specialization III (me, 5 CP)			Linear Model / Matrices OR Complex Problem Solving (me, 5 CP)
Year 2	Entrepreneurship & Innovation (m, 7.5 CP)	Judgement & Decision (m, 5 CP)	Org. Psych. & Comm. (m, 5 CP)	Applied Machine Learning (m, 7.5 CP)	Econometrics (m, 5 CP)	Causation/ Correlation*** (m, 2.5 CP)
	Design Thinking, E-Business & E- Services (m, 2.5 CP)	Social Cognition (m, 5 CP)		Data Analytics and Modeling (m, 7.5 CP)	Marketing and Methods (m, 5 CP)	Logic*** (m, 2.5 CP)
	Digital Transformation and Information Economy (m, 5 CP)			Introduction to Finance and Accounting (m, 7.5 CP)	Essentials of Social Psychology (m, 7.5 CP)	Data Structures and Processing (m, 7.5 CP)
Year 1	Introduction to International Business (m, 7.5 CP)	Essentials of Cognitive Psychology (m, 7.5 CP)	Introduction to Data Science (m, 7.5 CP)	Applied Calculus (m, 5 CP)	German I* (me, 2.5 CP)	
						CONSTRUCTOR TRACK 45 CP

„Disciplinary Skills“ CHOICE / CORE / CAREER
3 x 45 = 135 CP

m = mandatory
me = mandatory elective

* Humanities alternatives available
** Study Abroad Option in 5th Semester (20 CP)
*** Different module perspectives available

5 Study and Examination Plan

Management, Decisions and Data Analytics											Constructor Track Modules (General Education)																					
Matriculation Fall 2023																																
Program-Specific Modules					Type	Assessment	Period	Status ¹	Sem.	ECTS						Type	Assessment	Period	Status ¹	Sem.	ECTS											
Year 1 - CHOICE										45	Year 1 - CHOICE										15											
<i>Take the mandatory CHOICE unit(s) listed below, this is a requirement for the MDDA program.</i>																																
Modules Code										Unit: Management I	15	Module Code										Unit: Methods	10									
CH-300										Module: Introduction to International Business	m	1	7.5	JTMS-MAT-08										Applied Calculus	m	1	5					
CH-300-A					Introduction to International Business Lecture	Lecture				5	JTMS-08					Applied Calculus	Lecture	Written Exam	Exam period													
CH-300-B					Introduction to International Business Seminar	Seminar	Written examination	Exam period		2.5	CTMS-MET-03					Module: Applied Statistics with R	m	2	5	CTMS-03					Applied Statistics with R	Lecture&Lab	Written Exam	Exam period				
CH-301										Module: Introduction to Finance and Accounting	m	2	7.5																			
CH-301-A					Introduction to Finance	Seminar				2.5																						
CH-301-B					Introduction to Accounting	Seminar	Written examination	Exam period		2.5																						
CH-301-C					Finance and Accounting Tutorial	Tutorial				2.5																						
Unit: Decision I												15	Unit: German Language and Humanities (choose one module for each semester)												5							
CH-340										Module: Essentials of Cognitive Psychology	m	1	7.5	German is default language and open to Non-German speakers (on campus and online). ³																		
CH-340-A					Essentials of Cognitive Psychology	Lecture	Written examination	Exam period		7.5	JTLA-xxx										Module: Language 1	me	1	2.5								
CH-341										Module: Essentials of Social Psychology	m	2	7.5	JTLA-xxx										Language 1	Seminar	Various	Various	me				
CH-341-A					Essentials of Social Psychology	Lecture	Written examination	Exam period		7.5	JTLA-xxx										Module: Language 2	me	2	2.5								
													JTLA-xxx										Language 2	Seminar	Various	Various	me					
Unit: Data Analytics I												15	CTHU-HUM-001										Humanities Module: Introduction into Philosophical Ethics	me	1	2.5						
CH-340										Introduction to Data Science	m	1	7.5	CTHU-001										Introduction into Philosophical Ethics	Lecture (online)	Written Exam	Exam period	me				
CH-700-A					Introduction to Data Science	Lecture (online)	Written examination	Exam period		7.5	CTHU-HUM-002										Humanities Module: Introduction to the Philosophy of Science	me	2	2.5								
CH-701										Module: Data Structures and Processing	m	2	7.5	CTHU-002										Introduction to the Philosophy of Science	Lecture (online)	Written Exam	Exam period	me				
CH-701-A					Data Structures and Processing	Lecture (online)	Written examination	Exam period		7.5	CTHU-HUM-003										Humanities Module: Introduction to Visual Culture	me	2	2.5								
													CTHU-003										Introduction to Visual Culture	Lecture (online)	Written Exam	Exam period	me					
Year 2 - CORE										45	Year 2 - CORE										15											
<i>Take all three units listed below</i>																																
Unit: Management II												15	Unit: Methods												10							
CO-611										Module: Digital Transformation and Information Economy	m	3	5	CTMS-MET-20										Module: Marketing & Methods	m	3	5					
CO-611-A					Digital Transformation and Information Economy	Seminar	Presentation	During the semester		5	CTMS-20					Marketing & Methods	Lecture	Presentation	during the semester	m	5											
CO-612-A										Module: Design Thinking, E-Business & E-Services	m	3	2.5	JTMS-MET-05										Module: Econometrics	m	4	5					
CO-612-A					Design Thinking, E-Business & E-Services	Seminar	Presentation	During the semester		2.5	JTMS-05					Econometrics	Seminar	Written Exam	Exam period													
CO-603										Module: Entrepreneurship and Innovation	m	4	7.5																			
CO-603-A					Entrepreneurship and Innovation	Seminar	Project	During the semester		7.5																						
Unit: Decision II												15	Unit: New Skills												5							
CO-681										Module: Social Cognition	m	3	5	CTNS-NSK-01/02										Module: Logic	m	3	2.5					
CO-681-A					Social Cognition	Seminar	Term paper	during the semester		2.5	CTNS-01					Logic (perspective I)	Lecture (online)	Written Exam	Exam period	me	2.5											
CO-681-B					Social Cognition Lab	Lab	Lab report	during the semester		2.5	CTNS-02					Logic (perspective II)	Lecture (online)	Written Exam	Exam period	me	2.5											
CO-686										Module: Judgment & Decision Making	m	4	5	CTNS-NSK-03/04										Module: Correlation and Causation	m	4	2.5					
CO-686-A					Judgment & Decision Making	Seminar	Written examination	Exam period		5	CTNS-03					Causation and Correlation (perspective I)	Lecture (online)	Written Exam	Exam period	me	2.5											
CO-682										Module: Organizational Psychology & Communication	m	3/4	5	CTNS-04										Causation and Correlation (perspective II)	Lecture (online)	Written Exam	Exam period	me	2.5			
CO-682-A					Organizational Psychology	Seminar	Written examination	Exam period		4	2.5																					
CO-682-B					Communication and Interaction	Seminar	Written examination	Exam period		3	2.5																					
Unit: Data Analytics II												15																				
CO-710										Module: Analytics and Modelling	m	3	7.5																			
CO-710-A					Data Analytics and Modelling	Lecture	Written Exam	Exam period		m	7.5																					
CO-711										Module: Applied Machine Learning	m	4	7.5																			
CO-711-A					Applied Machine Learning	Lecture	Written Exam	Exam period		m	7.5																					

Year 3 - CAREER										45	15
CA-INT-900	Module: Summer Internship								m	4/5	15
CA-INT-900-0	Summer Internship										15
CA-MDDA-800	Module: Seminar / Thesis MDDA								m	6	15
CA-MDDA-800-S	Thesis seminar MDDA	Seminar	Presentation								3
CA-MDDA-800-T	Thesis MDDA	Thesis	Thesis								12
	Unit: Specialization² (Take a total of 15 CP of specialization modules)								m		15
MDE-CO-02	Module: Data Analytics								me	5	5
MDE-CO-02	Data Analytics	Lecture	project report	during the semester							5
CA-S-IBA-803	Module: Contemporary Topics in Marketing								me	5	5
CA-IBA-803	Contemporary Topics in Marketing	Seminar	Term paper	during the semester							5
CA-S-GEM-801	Module: Advanced Econometrics								me	5	5
CA-GEM-801	Advanced Econometrics	Seminar	Term paper	during the semester							5
XXXXX	Module: Financial Data Analytics								me	5	5
XXXXX	Financial Data Analytics	Seminar	Term paper	during the semester							5
Total ECTS											180
¹ Status (m = mandatory, e = elective, me = mandatory elective) ² For a full listing of all CHOICE / CORE / CAREER / Constructor Track units / modules please consult the CampusNet online catalogue and/or the study program handbooks. ³ German native speakers will have alternatives to the language courses (in the field of Humanities).											

Unit: New Skills										10		
Choose one of the two modules												
CTNS-NSK-05	Module: Linear Model / Matrices									me	5	5
CTNS-05	Linear Model / Matrices	Seminar (online)	Written Exam	Exam period							5	
CTNS-NSK-06	Module: Complex Problem Solving								me	5	5	
CTNS-06	Complex Problem Solving	Lecture (online)	Written Exam	Exam period							5	
Take this module either in semester 5 or 6												
CTNS-NSK-07/08	Module: Argumentation, Data Visualization and Communication								m	5/6	5	
CTNS-07	Argumentation, Data Visualization and Communication (perspective I)	Lecture (online)	Written Exam	Exam period							5	
CTNS-08	Argumentation, Data Visualization and Communication (perspective II)	Lecture (online)	Presentation	During the Semester							5	
Choose one of the two modules												
CTNS-NSK-09	Module: Agency, Accountability & Leadership								me	6	5	
CTNS-09	Agency, Accountability & Leadership	Lecture (online)	Written Exam	Exam period							5	
CTCI-CI-950	Module: Community Impact Project								me	5/6	5	
CTCI-950	Community Impact Project	Project	Project	During the Semester							5	

Figure 1: Study and Examination Plan

6 Management, Decisions and Data Analytics Modules

6.1 Introduction to International Business

Module Name Introduction to International Business		Module Code CH-300	Level (type) Year 1 (CHOICE)	CP 7.5
Module Components				
<i>Number</i>	<i>Name</i>	<i>Type</i>	<i>CP</i>	
CH-300-A	Introduction to International Business	Lecture	5	
CH-300-B	Introduction to International Business - Seminar	Seminar	2.5	
Module Coordinator Prof. Dr. Christoph Lattemann	Program Affiliation <ul style="list-style-type: none"> International Business Administration (IBA) 	Mandatory Status Mandatory for IBA, GEM IEM, MDDA, and minor EIM		
Entry Requirements		Frequency	Forms of Learning and Teaching	
<i>Pre-requisites</i> <input checked="" type="checkbox"/> None	<i>Co-requisites</i> <input checked="" type="checkbox"/> None	Annually (Fall)	<ul style="list-style-type: none"> Lecture (35 hours) Seminar (17.5 hours) Private studies on cases (50 hours) Private studies on content (85 hours) 	
<i>Knowledge, Abilities, or Skills</i> <ul style="list-style-type: none"> None 		Duration 1 semester	Workload 187.5 hours	
Recommendations for Preparation None				
Content and Educational Aims <p>This module provides the basics needed for making informed and effective business decisions in today's global economy. It focuses on the domains of business such as international strategy and organizational structure, selecting and managing entry modes, developing and marketing products internationally and managing international operations. Issues of globalization, cross-cultural businesses, politics and law in business, economic systems and development, international trade, and international financial markets will also be covered. Upon completing the module, students will know how to use a number of international business analytical tools, and have experience with case study analysis: including, PEST, CAGE, International Market Selection and Modes of Entry. Global corporate social responsibility and sustainability issues will also be discussed.</p>				
Intended Learning Outcomes <p>By the end of this module, students will be able to</p> <ol style="list-style-type: none"> understand and describe the process of globalization and how it affects markets and production e.g. identify the two forces causing globalization to increase, identify the types of companies that participate in international business, describe the global business environment and identify its four main elements; describe culture and explain the significance of both national culture and subcultures, identify the components of culture and the impact on business, describe the two main frameworks used to classify cultures and explain their practical use; 				

Intended Learning Outcomes (cont.)

3. describe each main type of political system. Identify the origins of political risk and how managers can reduce its effects. List the main types of legal systems and explain how they differ. Describe the major legal and ethical issues facing international companies;
4. describe what is meant by a centrally planned economy and explain why its use is declining. Identify the main characteristics of a mixed economy and explain the emphasis on privatization. Describe the different ways to measure a nation's level of development;
5. discuss international trade and trade patterns. Explain absolute advantage and comparative advantage and identify their differences. Explain the factor proportions and international product life cycle theories as well as trade and national competitive advantage theories;
6. describe the political, economic, and cultural motives behind governmental intervention in trade. List and explain the methods governments use to promote and restrict international trade;
7. define regional economic integration and identify its five levels. Discuss the benefits and drawbacks associated with regional economic integration;
8. discuss international capital market, international bond, international equity, and Eurocurrency markets. Discuss the four primary functions of the foreign exchange market. Explain how currencies are quoted and the different rates given;
9. explain how exchange rates influence the activities of domestic and international companies. Identify the factors that help determine exchange rates and their impact on business;
10. identify international strategies and the corporate-level strategies that companies use;
11. discuss the important issues that influence the choice of organizational structure;
12. explain why and how companies use exporting, importing, and countertrade. Explain the various means of financing export and import activities. Describe the different contractual entry modes that are available to companies. Discuss the important strategic factors in selecting an entry mode;
13. explain the impact globalization is having on international marketing activities. Understand the various dimensions for developing international product, promotional, pricing and distribution strategies (4P's marketing mix);
14. use concepts, tools and frameworks and apply them in the international business context. Develop and improve your analytical and critical thinking skills by applying them to contemporary international business issues. Improve communication skills like reading, writing, speaking, and listening. Prepare and deliver oral presentations as well as written works either prepared individually or as a team. Improve your research skills by analyzing real business situations, identifying problems, evaluating and discussing options and prepare recommendations. These recommendations need to be fact-based, undertaken qualitative and quantitative analyses.

Indicative Literature

Peng, M., Meyer K. (2019). International Business, 3 ed, Boston: Cengage Learning EMEA.

Usability and Relationship to other Modules

- Pre-requisite for all 2nd-year IBA CORE modules

Examination Type: Module Examination

Assessment Type: Written examination

Duration: 120 minutes

Weight: 100%

Scope: all intended learning outcomes

Module achievement: Preparation of case studies is prerequisite to attend the written examination.

Completion: To pass this module, the examination has to be passed with at least 45%.

6.2 Introduction to Finance and Accounting

Module Name Introduction to Finance and Accounting		Module Code CH-301	Level (type) Year 1 (CHOICE)	CP 7.5
Module Components				
<i>Number</i>	<i>Name</i>	<i>Type</i>		<i>CP</i>
CH-301-A	Introduction to Finance	Seminar		2.5
CH-301-B	Introduction to Accounting	Seminar		2.5
CH-301-C	Finance and Accounting Tutorial	Tutorial		2.5
Module Coordinator Prof. Dr. Andreas Seebeck	Program Affiliation • International Business Administration (IBA)		Mandatory Status Mandatory for IBA, GEM, IEM, MDDA, and minor EIM	
Entry Requirements		Frequency	Forms of Learning and Teaching	
<i>Pre-requisites</i>	<i>Co-requisites</i>	Annually (Spring)	<ul style="list-style-type: none"> • Seminars (35 hours) • Tutorial (17.5 hours) • Private Study (135 hours) 	
<input checked="" type="checkbox"/> Introduction to International Business	<input checked="" type="checkbox"/> none			
		• None.	1 semester	187.5 hours
Recommendations for Preparation				
None				
Content and Educational Aims				
<p>This module introduces students to basic financial and accounting techniques necessary to supplement business decision-making. The module is split into three sub-parts. The first part focuses on finance and investment and will provide students with the basics of corporate finance and investments. It will offer an overview of the different sources of finance from private and public sources and it will introduce the analytical tools and the necessary techniques for the financial management of a firm. It further provides the foundation for the basic domains of entrepreneurial finance, financing small- and medium enterprises and accessing capital markets. This also includes structuring financial activities in projects, funds, mergers and acquisition.</p> <p>The second part focuses on measuring the financial position and performance of a firm, on reporting cash flows and on analyzing financial statements. The perspective, thereby, lies on purposes of accounting, principal accounting procedures, sources and recording of data, the verification of accounting records, principles of financial statements, preparation, analysis and interpretation of financial statements, international accounting standards (IFRS), and principles and policies and their differences.</p> <p>The third part of the module is designed as tutorial. In the tutorial students will repeat, apply and practice the techniques from both seminars. Students work on exercises individually and in small groups.</p>				

Intended Learning Outcomes

By the end of this module, students should be able to:

1. understand the theoretical foundation of corporate finance
2. understand how public and private financial markets and organizations work
3. differentiate the variety of financing sources for companies
4. develop a sound understanding how to structure investments
5. identify and explain the financial structure of firms
6. identify and describe the major functions of financial reporting
7. describe and explain the relationship between financial statement elements
8. describe the roles and desirable attributes of financial reporting standards
9. describe and explain the elements of the balance sheet
10. describe, explain and classify cash flow items
11. describe and explain tools and techniques used in financial analysis and calculate ratios
12. describe and explain characteristics of financial reporting quality

Indicative Literature

Phillips, F., Libby, R., Libby P. (2015). Fundamentals of Financial Accounting, 5th Edition. New York: McGraw-Hill Education.

Fraser, L.M., Ormiston, A. (2015). Understanding Financial Statements, 11th Edition, London: Pearson.

Hisrich, R., Peters, M., Shepherd D (2017). Entrepreneurship & Innovation, 10th Edition, New York: McGraw-Hill.

Usability and Relationship to other Modules

- Pre-requisite for all 2nd year IBA CORE modules
- Builds on the module "Introduction to International Business"
- The module prepares students for the CORE modules in the second and third study year

Examination Type: Module Examination

Assessment Type: Written examination

Duration: 120 minutes

Weight: 100%

Scope: All intended learning outcomes of the module.

Completion: To pass this module, the examination has to be passed with at least 45%.

6.3 Essentials of Cognitive Psychology

Module Name Essentials of Cognitive Psychology		Module Code CH-340	Level (type) Year 1 (CHOICE)	CP 7.5
Module Components				
Number	Name	Type		CP
CH-340-A	Essentials of Cognitive Psychology	Lecture		7.5
Module Coordinator N.N.	Program Affiliation <ul style="list-style-type: none"> Integrated Social and Cognitive Psychology (ISCP) 		Mandatory Status Mandatory for ISCP, minor ISCP, and MDDA	
Entry Requirements			Frequency	Forms of Learning and Teaching
<i>Pre-requisites</i>	<i>Co-requisites</i>	<i>Knowledge, Abilities, or Skills</i>	Annually (Fall)	<ul style="list-style-type: none"> Lecture (52.5 hours) Private study (135 hours)
<input checked="" type="checkbox"/> None	<input checked="" type="checkbox"/> None	<ul style="list-style-type: none"> none 	Duration 1 semester	Workload 187.5 hours
Recommendations for Preparation				
None.				
Content and Educational Aims				
<p>The module provides a comprehensive overview of the major fields of cognitive psychology and beyond. It focuses on how humans attend and perceive their environment; learn and remember information; solve problems and make decisions; differ in intelligence and personality; communicate via language; experience emotions; and what drives them (motivation) etc. The module covers the historical foundations of psychology, current influential theories and models as well as empirical research methods. This module also includes methods for critical thinking (evaluating current approaches and research results); the scientific cycle, including the basics of theory of science. The emphasis of this module is on human behavior, and it provides the basis for all other modules in psychology and prepares students for subsequent CORE and Specialization modules.</p>				
Intended Learning Outcomes				
<p>By the end of this module, you will be able to:</p> <ol style="list-style-type: none"> explain basic concepts in psychology (sensation, perception, learning, memory, problem solving, decision making, intelligence, personality, language, emotion, motivation); explain the difference between scientific psychology and everyday psychology; identify the limitations of theoretical approaches. 				
Indicative Literature				
Not Specified				
Usability and Relationship to other Modules				
<ul style="list-style-type: none"> Pre-requisite for all psychology modules 				

Examination Type: Module Examination

Assessment Type: Written examination

Duration: 180 Minutes

Weight: 100%

Scope: All intended learning outcomes of the module.

Completion: To pass this module, the examination has to be passed with at least 45%.

6.4 Essentials of Social Psychology

Module Name Essentials of Social Psychology		Module Code CH-341	Level (type) Year 1 (CHOICE)	CP 7.5
Module Components				
<i>Number</i>	<i>Name</i>		<i>Type</i>	<i>CP</i>
CH-341-A	Essentials of Social Psychology		Lecture	7.5
Module Coordinator Prof. Dr. Ulrich Kühnen	Program Affiliation <ul style="list-style-type: none"> Integrated Social and Cognitive Psychology (ISCP) 	Mandatory Status Mandatory for ISCP, minor ISCP, and MDDA		
Entry Requirements		Frequency	Forms of Learning and Teaching	
<i>Pre-requisites</i>	<i>Co-requisites</i>	<i>Knowledge, Abilities, or Skills</i>	annually (Spring)	<ul style="list-style-type: none"> Lecture (52.5 hours) Private study (135 hours)
<input checked="" type="checkbox"/> None	<input checked="" type="checkbox"/> None	<ul style="list-style-type: none"> none 	Duration 1 semester	Workload 187.5 hours
Recommendations for Preparation				
None.				
Content and Educational Aims				
<p>In this module, you will begin to explore the influence that the actual or perceived presence of others can have on people's behaviors, thoughts, judgments and emotions – which are very much influenced by contextual factors such as the living environment, the social structure, or the political sphere, to name a few. However, context also refers to factors that influence how an object or a person is perceived, such as the perceiver's mood, expectations, needs and prior knowledge of a perceiver. Other social psychology issues of interest include how people interact, how inter-group conflict can be understood, and when people help each other or aggress against each other.</p> <p>This module reviews important aspects of social psychological research, which then will be discussed in more detail in the respective CORE and Specialization seminars. Therefore, you will be familiarized with fundamental theories and concepts such as theories of attribution, dissonance, and self-perception theory, person perception and social encoding, stereotypes, inter-group conflict, motivation, and social identity.</p>				
Intended Learning Outcomes				
By the end of this module, you will be able to				
<ol style="list-style-type: none"> explain seminal individual-level and group-level theories of social psychology; explain major research approaches to psychological phenomena; analyze selected current social debates (e.g., about migration) in social psychological terms name and describe relationships with related sciences (e.g., biology, sociology); describe current 'hot topics' in social psychological research. 				

Indicative Literature

Gilovich, T., Keltner, D., Chen, S. & Nisbett, R. (2018). *Social Psychology*. 5th International Student Edition. New York: W.W. Norton & Company Ltd.

Usability and Relationship to other Modules

- Pre-requisite for all psychology modules.

Examination Type: Module Examination

Assessment Type: Written examination

Duration: 180 Minutes

Weight: 100%

Scope: All intended learning outcomes of the module.

Completion: To pass this module, the examination has to be passed with at least 45%.

6.5 Introduction to Data Science

Module Name Introduction to Data Science		Module Code CH-700	Level (type) Year 1	ECTS 7.5
Module Components				
<i>Number</i>	<i>Name</i>	<i>Type</i>		<i>ECTS</i>
CH-700-A	Introduction to Data Science	Lecture (online)		7.5
Module Coordinator	Program Affiliation		Mandatory Status	
Prof. Dr. Hilke Brockmann, Prof. Dr. Adalbert Wilhelm, Prof. Dr. Joachim Vogt	<ul style="list-style-type: none"> Minor in Data Science 		Mandatory for CSSE, MDDA and Minor in Data Science	
Entry Requirements		Frequency	Forms of Learning and Teaching	
<i>Pre-requisites</i>		Annually (Fall)	<ul style="list-style-type: none"> Lectures (hybrid / online) (52.5 hours) Private Study (135 hours) 	
<input checked="" type="checkbox"/> None	<i>Co-requisites</i> <input checked="" type="checkbox"/> None			
		Duration	Workload	
		1 semester	187.5 hours	
Recommendations for Preparation				
None.				
Content and Educational Aims				
<p>The module introduces data science with an integrated presentation of three essential components, namely, (1) societal/legal implications and business opportunities, (2) technical/theoretical background and case studies, (3) an introduction to the Python coding environment. The first component entails a conceptual introduction to the opportunities and the challenges of a digitally transformed and data-driven society, presentations on industry standards and legal frameworks, and discussions of critical issues such as cybersecurity and surveillance. The second component includes topics such as data science terminology, digital data and their representations, and introductions to exploratory data analysis and prominent supervised and unsupervised learning tasks. The third component offers an introduction to the Python ecosystem of data representation, processing, analysis, and visualization, starting with Jupyter notebooks, installing suitable environments, and introductions to data science related packages such as NumPy, SciPy, Matplotlib, Seaborn, and Pandas. Fundamental data science concepts are summarized and illustrated using real-world data from various disciplines. Flexible educational formats (mostly online and hybrid) allow for asynchronous learning. Lectures are combined with an exposure to Python programming and data processing and visualization environments, including hands-on practicals, examples, and exercises.</p>				

Intended Learning Outcomes

By the end of this module, students will be able to

1. explain societal implications of the digital transformation,
2. understand the legal data protection framework,
3. carry out basic data processing and visualization tasks,
4. apply fundamental data science methods to structured data,
5. understand the logic of Python scripts and functions,
6. compose Python code using templates

Indicative Literature

Ani Adhikari, John DeNero, David Wagner. Computational and Inferential Thinking: The Foundations of Data Science. Originally developed for the UC Berkeley course [Data 8: Foundations of Data Science](#). An online version of the textbook is available at <https://inferentialthinking.com/>.

The Alan Turing Institute, [Data Science for the Social Good](#).

Philip D . Brooker. Programing with Python for Social Scientists. Sage 2020.

Shin Takahasi, Iroha Inoue. The Manga Guide to Linear Algebra. Trend-Pro 2012.

Steven S. Skiena. The Data Science Design Manual. Springer 2017.

Jake Vanderplas. Python Data Science Handbook. O'Reilly 2016. An online version is available at <https://jakevdp.github.io/PythonDataScienceHandbook/>.

Shoshana Zuboff. The Age of Surveillance Capitalism. London: Profile 2019.

Usability and Relationship to other Modules

Examination Type: Module Examination

Type: Written Examination

Duration/Length: 180 min

Scope: All intended learning outcomes of the module.

Weight: 100 %

Module achievement: 50% of the assignments need to be correctly solved.

Completion: To pass this module, the examination has to be passed with at least 45%.

6.6 Data Structures and Processing

Module Name		Module Code	Level (type)	CP
Data Structures and Processing		CH-701	Year 1	7.5
Module Components				
Number	Name	Type		CP
CH-701-A	Data Structures and Processing	Lecture (online)		7.5
Module Coordinator	Program Affiliation		Mandatory Status	
Dr. Carlos Brandt	<ul style="list-style-type: none"> Minor in Data Science 		Mandatory for MDDA and Minor in Data Science	
Entry Requirements		Frequency	Forms of Learning and Teaching	
<i>Pre-requisites</i>	<i>Co-requisites</i>	Annually (Spring)	<ul style="list-style-type: none"> Lectures (hybrid / online) (52.5 hours) Private Study (135 hours) 	
<input checked="" type="checkbox"/> none	<input checked="" type="checkbox"/> none			
		Duration	Workload	
		1 semester	187.5 hours	
Recommendations for Preparation				
Required for solving the coding assignments are Python skills at the level achieved after successful completion of the module Introduction to Data Science.				
Content and Educational Aims				
<p>In this module, data structures and the data analysis pipeline are introduced in three parts. The first part gives an overview of the data analysis pipeline from capturing and processing to storing and analyzing data. Database concepts and management as well as the basic distinction between structured and unstructured data are reviewed, including an introduction to the relational data model, supplemented by examples of how specific disciplinary databases are handled. The second part is concerned with different types of structured data, starting with time series and images as examples of ordered data vectors and data matrices, respectively, and addressing both numeric and text data. Particular emphasis will be on tables and their higher-dimensional extensions, allowing for multivariate correlation and regression studies. The third part deals with unstructured data as obtained from web scraping and text mining. Unstructured data need to be prepared for subsequent analyses and use through operations such as merging, ordering, transforming, and resampling. Flexible educational formats (mostly online and hybrid) allow for asynchronous learning. Lectures are combined with Python exercises with particular emphasis on the Pandas package. Disciplinary applications and case studies are immersed as bridging elements.</p>				
Intended Learning Outcomes				
<p>Upon completion of this module, students will be able to:</p> <ol style="list-style-type: none"> 1. enumerate and explain key operations along the data analysis pipeline, 2. understand the basics of database management and important data models, 3. process ordered data sets such as time series and images, 4. prepare unstructured data sets for processing and analysis, 5. apply the Pandas package to process and display time series, images, and tables, 6. use Python tools to prepare and process unstructured data. 				

Indicative Literature

- Ani Adhikari, John DeNero, David Wagner. Computational and Inferential Thinking: The Foundations of Data Science. Originally developed for the UC Berkeley course [Data 8: Foundations of Data Science](#). An online version of the textbook is available at <https://inferentialthinking.com/>.
- Steven S. Skiena. The Data Science Design Manual. Springer 2017.
- Jake Vanderplas. Python Data Science Handbook. O'Reilly 2016. An online version is available at <https://jakevdp.github.io/PythonDataScienceHandbook/>.

Usability and Relationship to other Modules

Examination Type: Module Examination

Type: Written Examination

Scope: All intended learning outcomes of the module.

Duration/Length: 180 min

Weight: 100 %

Module achievement: 50% of the assignments need to be correctly solved.

Completion: To pass this module, the examination has to be passed with at least 45%.

6.7 Digital Transformation and Information Economy

Module Name Digital Transformation and Information Economy		Module Code CO-611	Level (type) Year 2 (CORE)	CP 5
Module Components				
Number	Name	Type		CP
CO-611-A	Digital Transformation and Information Economy	Seminar		5
Module Coordinator Prof. Dr. Christoph Lattemann	Program Affiliation <ul style="list-style-type: none"> International Business Administration (IBA) 	Mandatory Status Mandatory Elective for IBA Mandatory for EIM minor and MDDA		
Entry Requirements		Frequency	Forms of Learning and Teaching	
Pre-requisites	Co-requisites	Annually (Fall)	<ul style="list-style-type: none"> Lectures, including case studies and presentations (35 hours) Private Study (90 hours) 	
<input checked="" type="checkbox"/> Introduction to International Business and Introduction to Finance and Accounting	<input checked="" type="checkbox"/> None Basic knowledge of management concepts and economics			
		Duration	Workload	
		1 semester	125 hours	
Recommendations for Preparation This module is based on the knowledge students acquired in the CHOICE modules during the first study year.				
Content and Educational Aims <p>Information is a key resource in today's business operations and an important tool for decision-making. This module provides the basics for making informed and effective business decisions in today's information economy. The content of this module is located in the intersection of the Information Economy, Electronic Business, Electronic Commerce, and Electronic Services.</p> <p>The overall goal of this module is to help students to learn, understand and practice entrepreneurial and innovation processes in the information age. The "Digital Transformation and Information Economy" module helps students to understand today's real-life challenges and problems and to explain complex problems coherently and concisely. Further, students learn to develop and present innovative user-centered and theory-oriented solutions for real-world challenges in an IT-driven world.</p> <p>The module is strongly based on the paradigm of user-centeredness, the user centered design of services and the ideas of Service Dominant Logic. Service-dominant (S-D) logic is a meta-theoretical framework for explaining value creation, through exchange, among configurations of actors. One underlying idea of S-D logic is that goods are a distribution mechanism for co-created service provision.</p> <p>In the information age, these co-created services can be supported and enhanced through information technologies (applications and devices). Hence, new technologies enable humans to apply their competences to benefit others and reciprocally benefit from others' applied competences through service-for-service exchange in a more advanced way.</p> <p>Major challenges and concerns of the digital transformation and information economy will be reflected:</p> <ul style="list-style-type: none"> the role of information in an information society globalization & strategic business information infrastructure new theories and concepts (such as service dominant logic, customer integration, gamification, P2P) new applications (e.g. Web 2.0 and Industry 4.0, Facebook, Twitter, Google, eBay, WeChat,...) new business models ethics and security. 				

The module will enable students to collaborate across disciplines with experts in other areas (in particular Design and Engineering) and to apply knowledge in areas of expertise other than their own (thus building so called t-shaped people).

Intended Learning Outcomes

By the end of this module, students should be able to

1. describe the role of information in the internet economy and in the digital transformation;
2. summarize and classify the new Web 2.0 and Industry 4.0 technologies;
3. Indicate the economic and business rules in the information age;
4. develop practical knowledge and management skills for digital transformation;
5. develop broad global and strategic perspectives;
6. develop sensitivity to international social responsibility and public interest issues from various perspectives;
7. explain the “service dominant logic” (SDL) for business/entrepreneurial activities and the power of new technologies (e.g. IoT) for customer relationship management;
8. improve their oral communication, group and individual presentation skills;
9. work better as individuals, group members, and group leaders;
10. outline how business ethics are also applicable in the field of Information Systems and Management;
11. adapt to a new working culture based on a user-centricity, empathy, and playful testing.

Indicative Literature

Brynjolfsson, E., McAfee, A. (2016). The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies. New York: Norton & Company, ISBN-13: 978-0393350647, ISBN-10: 0393350649.
Laudon, K. C., Traver, C.G., (2011). Management Information Systems – Managing the Digital Firm (12th Edition). Upper Sadle River: Pearson; ISBN-10: 0-27-375453-X; ISBN-13: 978-0-27-375453-X.

Usability and Relationship to other Modules

- This module prepares students who are interested in the consequences of digitization and creative problem solving for their independent studies in the Bachelor Thesis module

Examination Type: Module Examination

Assessment Type: Group presentation

Duration: 40 minutes

Weight: 100%

Scope: All intended learning outcomes

Completion: To pass this module, the assessment has to be passed with at least 45%.

6.8 Design Thinking, E-Business & E-Service

Module Name Design Thinking, E-Business & E-Service		Module Code CO-612	Level (type) Year 2 (CORE)	CP 2.5
Module Components				
Number	Name	Type	CP	
CO-612-A	Design Thinking, E-Business & E-Services	Seminar	2.5	
Module Coordinator Prof. Dr. Christoph Lattemann	Program Affiliation <ul style="list-style-type: none"> International Business Administration (IBA) 	Mandatory Status Mandatory for MDDA Mandatory Elective for IBA		
Entry Requirements		Frequency	Forms of Learning and Teaching	
Pre-requisites	Co-requisites	Annually (Fall)	<ul style="list-style-type: none"> Project Work (Design Thinking) (17.5 hours) Private Study (45 hours) 	
<input checked="" type="checkbox"/> Introduction to International Business and Introduction to Finance and Accounting	<input checked="" type="checkbox"/> None Basic knowledge of management concepts and economics			
		Duration	Workload	
		1 semester	62.5 hours	
Recommendations for Preparation This module is based on the knowledge students acquired in the CHOICE modules during the first study year.				
Content and Educational Aims <p>This module helps students to improve their theoretical and practical skills in finding practical and innovative solutions for real-world challenges in a business environment.</p> <p>The Design Thinking approach has rapidly been adopted by some of the world's leading brands, such as Apple, Google, Samsung, and GE and the approach is being taught at leading universities around the world, including Stanford and Harvard.</p> <p>Design Thinking is a human-focused, prototype-driven process for innovation. Students will develop a solid understanding of the fundamental concepts of Design Thinking and will learn how to implement new found knowledge in their professional work life.</p>				
Intended Learning Outcomes By the end of this module, students should be able to				
<ol style="list-style-type: none"> 1. apply the fundamental concepts of Design Thinking by working through a complete innovation project 2. understand why Design Thinking is relevant in an IT-driven world. 3. apply ethnographic and analysis methods, which differ from classical market research, such as focus groups and surveys 4. initiate a new working culture based on a user-centric approach, empathy, and playful testing 5. apply early and fast prototyping as well as testing methods that will help reduce risks and accelerate organizational learning 6. work in a team of diverse people and in a diverse environment 				
Indicative Literature Jakob Schneider und Marc Stickdorn (2010) This is Service Design Thinking: Basics, Tools, Cases; Consortium Book Sales & Dist; ISBN: 9063692560, 9789063692568				
Usability and Relationship to other Modules <ul style="list-style-type: none"> This module prepares students who are interested in the consequences of digitization and creative problem solving for their independent studies in the Bachelor Thesis module 				

Examination Type: Module Examination

Assessment Type: Group presentation

Duration: 30 minutes

Weight: 100%

Scope: All intended learning outcomes

Completion: To pass this module, the assessment has to be passed with at least 45%.

6.9 Entrepreneurship and Innovation

Module Name Entrepreneurship and Innovation		Module Code CO-603	Level (type) Year 2 (CORE)	CP 7.5
Module Components				
<i>Number</i>	<i>Name</i>		<i>Type</i>	<i>CP</i>
CO-603-A	Entrepreneurship and Innovation		Seminar	7.5
Module Coordinator Prof. Dr. Sven Voelpel	Program Affiliation <ul style="list-style-type: none"> International Business Administration (IBA) 		Mandatory Status Mandatory for MDDA Mandatory elective for IBA	
Entry Requirements		Frequency	Forms of Learning and Teaching	
<i>Pre-requisites</i>	<i>Co-requisites</i>	<i>Knowledge, Abilities, or Skills</i>	<ul style="list-style-type: none"> Seminar (52.5 hours) Private Study (135 hours) 	
<input checked="" type="checkbox"/> Introduction to International Business and Introduction to Finance and Accounting	<input checked="" type="checkbox"/> None	<ul style="list-style-type: none"> None 		
		Duration	Workload	
		1 semester	187.5 hours	
Recommendations for Preparation				
This module is based on the knowledge students acquired in the CHOICE modules during the first study year. For preparation, students should recall the topics related to innovation and financial planning.				
Content and Educational Aims				
<p>Innovation is the principal source of sustainable competitive advantage for firms around the world. However, building an organization that can successfully and repeatedly bring innovations to market is a daunting managerial challenge. This module will focus on the practices and processes managers use to manage innovation effectively. Over the semester, several aspects will be examined with regard to innovation: such as exploring, executing, leveraging and renewing innovation. The focus will be on entrepreneurial organizations. The module is designed to provide a deep grounding in the field of innovation for managers and entrepreneurs whose goal is to play a leading role in innovation-driven firms. The material moves between strategic issues (what should you do?) and organizational and managerial issues (how should you get it done?). The focus of the module is on exemplifying and experiencing the innovation process and implementation. Students have to develop business ideas and business plans. They will also be trained to present their business ideas in a pitch.</p>				
Intended Learning Outcomes				
By the end of this module, students should be able to				
<ol style="list-style-type: none"> identify organizational, managerial and financial opportunities and challenges within businesses; create value in terms of products and services while forming a business idea; sell their ideas to investors using excellent oral and visual presentation skills; transform theoretical knowledge into creative approaches while solving real-world problems; 				

5. evaluate the needs of innovation and initiate creative processes to expand businesses;
6. analyze markets and identify the best opportunities for the company formation;

Indicative Literature

Phillips, F., Libby, R., Libby P. (2015). Fundamentals of Financial Accounting, 5th Edition. New York: McGraw-Hill Education.

Fraser, L.M., Ormiston, A. (2015). Understanding Financial Statements, 11th Edition, London: Pearson.

Hisrich, R., Peters, M., Shepherd D (2017). Entrepreneurship & Innovation, 10th Edition, New York: McGraw-Hill.

Usability and Relationship to other Modules

- This module prepares students who are interested in founding their own business or StartUp. As such the module can support students who would like to choose the StartUp – Option in the “Internship/ StartUp and Career Skills” module

Examination Type: Module Examination

Type: Project assessment

Weight: 100%

Scope: All intended learning outcomes

Completion: To pass this module, the assessment has to be passed with at least 45%.

6.10 Social Cognition

Module Name Social Cognition		Module Code CO-681	Level (type) Year 2 (CORE)	CP 5
Module Components				
<i>Number</i>	<i>Name</i>	<i>Type</i>	<i>CP</i>	
CO-681-A	Social Cognition	Seminar	2.5	
CO-681-B	Social Cognition Lab	Lab	2.5	
Module Coordinator Prof. Dr. Christian Stamov Roßnagel	Program Affiliation <ul style="list-style-type: none"> Integrated Social and Cognitive Psychology (ISCP) 		Mandatory Status Mandatory for MDDA Mandatory elective for ISCP	
Entry Requirements		Frequency	Forms of Learning and Teaching	
<i>Pre-requisites</i>		annually (Fall)	<ul style="list-style-type: none"> Seminar (35 hours) Private study (90 hours) 	
<input checked="" type="checkbox"/> Essentials of Cognitive Psychology	<i>Co-requisites</i> <input checked="" type="checkbox"/> None			
		1 semester	125 hours	
Recommendations for Preparation				
Social Cognition self-assessment on CampusNet.				
Content and Educational Aims				
<p>Individual experience is embedded in various social contexts ranging in layers of complexity from one's immediate social situation (e.g., others being present) to institutions (such as the workplace or the educational system) to cultural meaning systems. The components of this module investigate the dynamic and mutual relationship between individual actors and their social contexts across these layers of complexity. How is individual experience influenced by the actual or presumed presence of others? Do people act differently as members of social groups than they do as individuals? What are the implications of our insights into the social embeddedness of human behavior for interventions aimed at modifying behaviors?</p> <p>This module will promote your insight into recent developments in social psychology as well as help you acquire a broad and thorough understanding of today's most important topics in social psychological research. You will refine your methodological skills by analyzing extant research as well as designing new studies. Moreover, you will be given sufficient opportunity to familiarize yourself with the approaches to and issues of application-oriented research.</p>				
Intended Learning Outcomes				
By the end of this module, you will be able to				
<ol style="list-style-type: none"> explain seminal models and fundamental processes of social cognition and group processes; describe and critically evaluate the social-cognitive approach; analyze and contrast selected alternative explanations; explain major sources of individual-level and group-level social influence; name needs for and outline strategies to modify or extend current theories and models; apply social cognitive theorizing to explain or predict real-world phenomena. 				

Indicative Literature

Not specified

Usability and Relationship to other Modules

- Pre-requisite for certain Specialization modules in psychology (see Section 3.4 of the ISCP Handbook)

Examination Type: Module Component Examinations

Module Component 1: Seminar

Assessment Type: Term paper

Length: 2000 words

Weight: 50%.

Scope: Intended learning outcomes (1-5)

Module Component 2: Lab

Assessment Type: Lab report

Length 1500 Words

Weight: 50%

Scope: Intended learning outcomes (1-3, 6)

Completion: To pass this module, both module component examinations have to be passed with at least 45%.

6.11 Organizational Psychology & Communication

Module Name Organizational Psychology & Communication			Module Code CO-682	Level (type) Year 2 (CORE)	CP 5
Module Components					
<i>Number</i>	<i>Name</i>			<i>Type</i>	<i>CP</i>
CO-682-A	Organizational Psychology			Seminar	2.5
CO-682-B	Communication and Interaction			Seminar	2.5
Module Coordinator Prof. Dr. Christian Stamov Roßnagel	Program Affiliation <ul style="list-style-type: none"> Integrated Social and Cognitive Psychology (ISCP) 			Mandatory Status Mandatory for MDDA Mandatory elective for ISCP	
Entry Requirements			Frequency	Forms of Learning and Teaching	
<i>Pre-requisites</i>	<i>Co-requisites</i>	<i>Knowledge, Abilities, or Skills</i>	Annually (Fall)	<ul style="list-style-type: none"> Seminars (35 hours) Private study (90 hours) 	
<input checked="" type="checkbox"/> Essentials of Cognitive Psychology	<input checked="" type="checkbox"/> none	<ul style="list-style-type: none"> Basics of correlational statistics Concepts of generalizability, external, internal, and ecological validity 	Duration 2 semesters	Workload 125 hours	
Recommendations for Preparation					
Content and Educational Aims					
<p>Building on the conceptual and methodological foundations established in the Social Cognition module, the general question guiding this module is how insights into the socio-cultural embeddedness of human behavior can help us 'understand' (e.g., assess, diagnose) and change behavior in complex real-world settings. One such setting are organizations, i.e. structured social units in which people collaborate to reach collective goals. We explore how individual-level and organizational-level factors (e.g., climate) interact to shape workers' organizational behavior in terms of motivation, communication, and collaboration. We will pay special attention to the opportunities and challenges of the increasing diversity of people in contemporary organizations. Communication, and the social interaction it involves, is a fascinating example of both such opportunities and challenges. While communicative processes unfold differently as a function of the diversity contexts they are embedded in, at the same time those processes are the means to systematically influence social interactions in diverse groups, teams, and organizations in a solution-oriented manner. Different as communicative processes may be at the surface level (including, for instance, verbal interactions, nonverbal cues, and human-computer interaction), there are fundamental cognitive and social processes that underlie human communication in all its forms. We will look at how communication shapes personal relationships and differentiates potentially hazardous misunderstandings from successful interactions in a range of settings, such as sales communication, supervisor-employee interactions, therapeutic change talk, and conflict resolution and negotiation.</p> <p>In addition to providing you with insights into current 'hot topics' in social and cultural psychology, this module focuses on the approaches and contemporary issues of application-oriented research in both fields. Using case studies from actual consulting projects as examples, you will refine your skills for analyzing real-life situations in</p>					

a theory-based fashion and of designing strategies for assessments and interventions in selected communication settings.

Intended Learning Outcomes

By the end of this module, you will be able to

1. explain how quantitative theories may and may not be applied to individuals, groups, or organizations;
2. explain how evidence-based problem solutions are generated;
3. apply qualitative and quantitative methods to design case-specific data collection strategies;
4. demonstrate the ability to communicate high-level research findings to non-experts without information loss;
5. apply social influence theories to develop strategies for stakeholder management.

Indicative Literature

King, D. & Lawley, S. (2019). *Organizational Behaviour* (3e). Oxford: Oxford University Press. ISBN: 9780198807780

Röhner J. & Schütz, A. (2021). *Psychology of Communication*. Wiesbaden: Springer. ISBN 978-3-030-60169-0

Usability and Relationship to other Modules

- Pre-requisite for certain Specialization modules in psychology (see Section 3.4 of the ISCP Handbook).

Examination Type: Module Component Examinations

Module Component 1: Seminar

Assessment Type: Written examination

Duration: 60 minutes

Weight: 50%

Scope: All intended learning outcomes of the module.

Module Component 2: Seminar

Assessment Type: Written examination

Duration: 60 minutes

Weight: 50%

Scope: All intended learning outcomes of the module.

Completion: To pass this module, both module component examinations have to be passed with at least 45%.

6.12 Judgment & Decision Making

Module Name Judgment & Decision Making		Module Code CO-686	Level (type) Year 2 (CORE)	CP 5
Module Components				
<i>Number</i>	<i>Name</i>	<i>Type</i>	<i>CP</i>	
CO-686-A	Judgment & Decision Making	Seminar	5	
Module Coordinator Prof. Dr. Adele Diederich	Program Affiliation <ul style="list-style-type: none"> Integrated Social and Cognitive Psychology (ISCP) 		Mandatory Status Mandatory for MDDA Mandatory elective for ICSP	
Entry Requirements		Frequency	Forms of Learning and Teaching	
<i>Pre-requisites</i>	<i>Co-requisites</i>	<i>Knowledge, Abilities, or Skills</i>	Annually (Spring)	<ul style="list-style-type: none"> Seminar (35 hours) Private study (90 hours)
<input checked="" type="checkbox"/> Essentials of Cognitive Psychology	<input checked="" type="checkbox"/> None	<ul style="list-style-type: none"> Basics in probability theory Scientific writing 	Duration 1 semester	Workload 125 hours
Recommendations for Preparation				
None.				
Content and Educational Aims				
<p>Judgment and decision-making are broad and complex areas of great theoretical interest and practical impact in almost all of contemporary disciplines. The focus here is on psychological perspectives. Applications of decision-making research in marketing, medicine, law, and other areas are discussed. This module includes topics such as heuristics and biases, decision making under risk and uncertainty, preference and choice, confidence, and more.</p> <p>Upon successful completion of this module, you understand the models and methods of research in judgment and decision making. The aim of this module is to provide you with basic concepts from probability theory and expected utility theory to serve as a benchmark for evaluating judgments and decision-making. Psychological models of decision-making that describe human judgment and decision making are discussed. Historical background and classic paradigms are also provided to enable you to understand and evaluate current research.</p>				
Intended Learning Outcomes				
By the end of this module, you will be able to				
<ol style="list-style-type: none"> describe the major models and theories of behavioral decision making; explain this field's major methods, results, and controversies; select generalizable findings and apply them to solve actual decision-making problems; discuss applications of decision-making research in marketing, medicine, and law. 				

Indicative Literature

Not specified

Usability and Relationship to other Modules

Examination Type: Module Examination

Assessment Type: Written examination

Duration: 120 Minutes

Weight: 100%

Scope: All intended learning outcomes of the module.

Completion: To pass this module, the assessment has to be passed with at least 45%.

6.13 Data Analytics and Modeling

Module Name		Module Code	Level (type)	CP
Data Analytics and Modeling		CO-710	Year 2 (CORE)	7.5
Module Components				
Number	Name	Type		CP
CO-710-A	Data Analytics and Modeling	Lecture (online)		7.5
Module Coordinator	Program Affiliation		Mandatory Status	
N.N.	<ul style="list-style-type: none"> Minor in Data Science 		Mandatory for MDDA and Minor in Data Science	
Entry Requirements		Frequency	Forms of Learning and Teaching	
<i>Pre-requisites</i>	<i>Co-requisites</i>	Annually (Fall)	<ul style="list-style-type: none"> Lectures (hybrid / online) (52.5 hours) Private Study (135 hours) 	
<input checked="" type="checkbox"/> none	<input checked="" type="checkbox"/> none			
		Duration	Workload	
		1 semester	187.5 hours	
Recommendations for Preparation				
Required for solving the coding assignments are Python skills at the level achieved after successful completion of the module Introduction to Data Science. Furthermore, students are encouraged to review first-year level statistics and linear algebra.				
Content and Educational Aims				
The module offers an introduction to the principles of data analytics and predictive data modeling and is structured into four parts. First, essential concepts from statistics are reviewed in the data modeling context, illustrating key ideas including randomness, distributions, and confidence regions. Examples and case studies are discussed to distinguish between proper and improper uses of statistics. Basic linear algebra is reviewed in the second part of the module, emphasizing vectors, distances, linear equations, matrices, and inversion. Key ideas such as the least squares approach are motivated with geometrical principles. The third part of the module is concerned with matrix decompositions such as the Singular Value Decomposition (SVD) and its close relatives Principal Component Analysis (PCA) and Empirical Orthogonal Function (EOF) analysis. The fourth part clarifies the distinction between linear and nonlinear modeling, and introduces key nonlinear techniques. Flexible educational formats (mostly online and hybrid) allow for asynchronous learning. Lectures are combined with Python exercises. Disciplinary applications and case studies are immersed as bridging elements.				
Intended Learning Outcomes				
Upon completion of this module, students will be able to:				
<ol style="list-style-type: none"> 1. identify important problem types and solution approaches in data analytics, 2. understand how key concepts from statistics and linear algebra enter data science, 3. explain matrix decompositions and their usage in data science, 4. discuss regularization concepts and optimality criteria in data analytics, 5. know the basics of nonlinear modeling and related computational approaches, 6. convert data structures to Python/NumPy arrays for usage in data modeling, 7. apply Python statistics and linear algebra tools in data analytics and modeling. 				

Indicative Literature

- Ani Adhikari, John DeNero, David Wagner. Computational and Inferential Thinking: The Foundations of Data Science. Originally developed for the UC Berkeley course [Data 8: Foundations of Data Science](#). An online version of the textbook is available at <https://inferentialthinking.com/>.
- Steven S. Skiena. The Data Science Design Manual. Springer 2017.
- Gilbert Strang: Linear Algebra and Learning from Data. Wellesley-Cambridge 2019. See <https://math.mit.edu/~gs/learningfromdata/>.
- Joe Suzuki: Statistical Learning with Math and Python. Springer 2021.
- Jake Vanderplas. Python Data Science Handbook. O'Reilly 2016. An online version is available at <https://jakevdp.github.io/PythonDataScienceHandbook/>.

Usability and Relationship to other Modules

Examination Type: Module Examination

Type: Written Examination

Duration/Length: 180 min

Scope: All intended learning outcomes of the module.

Weight: 100 %

Module achievement: 50% of the assignments need to be correctly solved.

Completion: To pass this module, the assessment has to be passed with at least 45%.

6.14 Applied Machine Learning

Module Name		Module Code	Level (type)	CP
Applied Machine Learning		CO-711	Year 2 (CORE)	7.5
Module Components				
Number	Name	Type		CP
CO-711-A	Applied Machine Learning	Lecture (online)		7.5
Module Coordinator	Program Affiliation		Mandatory Status	
	<ul style="list-style-type: none"> Minor in Data Science 		Mandatory for MDDA and Minor in Data Science	
Entry Requirements		Frequency	Forms of Learning and Teaching	
<i>Pre-requisites</i>	<i>Co-requisites</i>	Annually (Fall)	<ul style="list-style-type: none"> Lectures (hybrid / online) (52.5 hours) Private Study (135 hours) 	
<input checked="" type="checkbox"/> none	<input checked="" type="checkbox"/> none			
		Duration	Workload	
		1 semester	187.5 hours	
Recommendations for Preparation				
Required for solving the coding assignments are Python skills at the level achieved after successful completion of the module Introduction to Data Science. Furthermore, students are encouraged to review first-year level statistics and linear algebra.				
Content and Educational Aims				
The module provides a hands-on introduction to Machine Learning (ML), emphasizing practical aspects of workflows and applications. Topics include k-Means clustering, Nearest Neighbor (NN) and Naive Bayes techniques, Decision Trees, Support Vector Machines (SVMs). Particular emphasis is on Neural Networks and Deep Learning. Theoretical concepts such as distance metrics, graphs, and networks are reviewed. Flexible educational formats (mostly online and hybrid) allow for asynchronous learning. Lectures are combined with Python exercises with particular emphasis on the SciKit-learn package. Disciplinary applications and case studies are immersed as bridging elements.				
Intended Learning Outcomes				
Upon completion of this module, students will be able to:				
<ol style="list-style-type: none"> enumerate and describe main Machine Learning (ML) tasks and applications, discern and explain important ML approaches to classification and regression, apply Nearest Neighbor and Naive Bayes techniques to classification problems, employ Decision Trees and Support Vector Machines to solve data science problems, understand and use Neural Network and Deep Learning techniques, address Machine Learning tasks by means of the Python library SciKit-learn (sklearn). 				
Indicative Literature				
<ul style="list-style-type: none"> Steven S. Skiena. The Data Science Design Manual. Springer 2017. Joe Suzuki: Statistical Learning with Math and Python. Springer 2021. Jake Vanderplas. Python Data Science Handbook. O'Reilly 2016. An online version is available at https://jakevdp.github.io/PythonDataScienceHandbook 				

Usability and Relationship to other Modules

Examination Type: Module Examination

Type: Written Examination

Duration/Length: 180 min

Scope: All intended learning outcomes of the module.

Weight: 100 %

Module achievement: 50% of the assignments need to be correctly solved.

Completion: To pass this module, the assessment has to be passed with at least 45%.

6.15 Data Analytics

Module Name Data Analytics		Module Code MDE-CO-02	Level (type) Year 1 (CORE)	CP 5
Module Components				
<i>Number</i>	<i>Name</i>	<i>Type</i>	<i>CP</i>	
MDE-CO-02	Data Analytics	Lecture	5	
Module Coordinator	Program Affiliation		Mandatory Status	
Prof. Dr. Adalbert F.X. Wilhelm	<ul style="list-style-type: none"> MSc Data Engineering 		Mandatory for DE Mandatory elective for DSSB, MDDA	
Entry Requirements			Frequency	Forms of Learning and Teaching
<i>Pre-requisites</i>			Annually (Fall)	<ul style="list-style-type: none"> Lecture (17.5 hours) Tutorials (17.5 hours) Private study (90 hours)
<input checked="" type="checkbox"/> None	<i>Co-requisites</i>	<i>Knowledge, Abilities, or Skills</i>		
	<input checked="" type="checkbox"/> None	<input checked="" type="checkbox"/> None	Duration	Workload
			1 semester	125 hours
Recommendations for Preparation				
Read the Syllabus. Take the free online course: Introduction to Data Science at https://cognitiveclass.ai/courses/data-science-101/				
Content and Educational Aims				
<p>This module introduces concepts and methods of data analytics. The objective of the module is to present methods for gaining insight from data and drawing conclusions for analytical reasoning and decision-making. The module comprises a broad spectrum of methods for modelling and understanding complex datasets. Comprising both descriptive and predictive analytics, the standard portfolio of supervised and unsupervised learning techniques is introduced. Automatic analysis components, such as data transformation, aggregation, classification, clustering, and outlier detection, will be treated as an integral part of the analytics process.</p> <p>As a central part of this module, students are introduced to the major concepts of statistical learning such as cross-validation, feature selection, and model evaluation. The course takes an applied approach and combines the theoretical foundation of data analytics with a practical exposure to the data analysis process.</p>				
Intended Learning Outcomes				
By the end of this module, students will be able to				
<ol style="list-style-type: none"> explain advanced data analytics techniques in theory and application; apply data analytics methods to real-life problems using appropriate tools; evaluate and compare different data analytics algorithms and approaches; apply statistical concepts to evaluate data analytics results. 				
Indicative Literature				
G. James, D.Witten, T. Hastie, Rob Tibshirani: Introduction to Statistical Learning with R by Springer, 2013 (ISLR) A. Telea, Data Visualization: Principles and Practice, Wellesley, Mass.: AK Peters, 1st edition, 2008.(DV) M. Ward, G. Grinstein, D. Keim, Interactive Data Visualization: Foundations, Techniques, and Applications. AK Peters, 1st edition, 2010. (IDV)				
Usability and Relationship to other Modules				
In this module students will learn concepts and various techniques for data analysis. They will be rigorously applied in MDE-CS-03 as well as in the applied projects MDE-DIS-02 and MDE-DIS-03, and typically also in the master thesis.				
Examination Type: Module Examination				
Assessment Type: Project Report			Length: 20 pages Weight: 100%	
Scope: All intended learning outcomes of this module.				

Completion: To pass this module, the assessment has to be passed with at least 45%.

6.16 Contemporary Topics in Marketing

Module Name Contemporary Topics in Marketing		Module Code CA-S-IBA-803		Level (type) Year 3 (Specialization)	CP 5
Module Components					
<i>Number</i>		<i>Name</i>		<i>Type</i>	<i>CP</i>
CA-IBA-803		Contemporary Topics in Marketing		Seminar	5
Module Coordinator Prof. Dr. Tilo Halaszovich		Program Affiliation <ul style="list-style-type: none"> International Business Administration (IBA) 			Mandatory Status Mandatory elective for IBA, GEM, and MDDA
Entry Requirements			Frequency	Forms of Learning and Teaching	
<i>Pre-requisites</i>	<i>Co-requisites</i>	<i>Knowledge, Abilities, or Skills</i>		Annually (Spring)	<ul style="list-style-type: none"> Seminar (35 hours) Private Studies (90 hours)
<input checked="" type="checkbox"/> Major in MDDA, IBA or GEM	<input checked="" type="checkbox"/> none	<ul style="list-style-type: none"> Basic Concepts of Marketing 		Duration 1 semester	
Recommendations for Preparation					
It is recommended that students chose the “Marketing” module in their second year to gain in-depth knowledge of basic marketing concepts prior to this specialization. Students should at least familiarize themselves with basic marketing concepts as outlined in the syllabus of the “Marketing” module.					
Content and Educational Aims					
The module aims to provide an overview and understanding of frontline topics in data-driven marketing. The purpose is also to stimulate interest in a further exploration of these topics, for continued research and thesis work. The overall objective is to provide students with an explicit marketing-based mindset and a set of conceptual, analytical, and practical tools with which to come to terms with contemporary marketing issues, thus enabling them to challenge and improve existing practices and theories.					
The module covers a set of marketing topics that (a) are important in contemporary marketing, from both a theoretical and practical point of view, and (b) have not received extensive coverage in previous marketing-related modules.					
Intended Learning Outcomes					
By the end of this module, students should be able to					
<ol style="list-style-type: none"> illustrate an understanding of contemporary topics in marketing relating to theories, models, research methods and empirical phenomena; analyze and assess published journal articles in the field of marketing; discuss contemporary marketing phenomena and practices; design an adequate empirical research approach for an analysis of a contemporary topic in marketing. 					
Indicative Literature					
Hanlon, A. (2019). Digital Marketing - Strategic Planning & Integration. Thousand Oakes: Sage.					

Usability and Relationship to other Modules

Examination Type: Module Examination

Assessment Type: Term paper

Length: 2500 words

Weight: 100%

Scope: All intended learning outcomes of the module.

Completion: To pass this module, the assessment has to be passed with at least 45%.

6.17 Advanced Econometrics

Module Name		Module Code	Level (type)	CP
Advanced Econometrics		CA-S-GEM-801	Year 3 (Specialization)	5
Module Components				
Number	Name	Type		CP
CA-GEM-801	Advanced Econometrics	Seminar		5
Module Coordinator	Program Affiliation		Mandatory Status	
Prof. Dr. Colin Vance	<ul style="list-style-type: none"> Global Economics and Management (GEM) 		Mandatory elective for GEM, IBA and MDDA	
Entry Requirements			Frequency	Forms of Learning and Teaching
<i>Pre-requisites</i>	<i>Co-requisites</i>	<i>Knowledge, Abilities, or Skills</i>	Annually (Fall)	<ul style="list-style-type: none"> Seminar (35 hours) Private Study (90 hours)
<input checked="" type="checkbox"/> Econometrics	<input checked="" type="checkbox"/> None	<ul style="list-style-type: none"> Notions of substantive versus statistical significance Basic knowledge of econometrics Academic writing skills 	Duration 1 semester	Workload 125 hours
Recommendations for Preparation				
Students prepare best for this module by reading Edward Leamer's seminal article "Let's take the con out of Econometrics," published in the American Economic Review in 1983. The article covers many of the key issues that econometricians still grapple with today, such as whether randomization is essential.				
Content and Educational Aims				
<p>The goal of this module is to build on the knowledge acquired in the "Econometrics" module, covering select advanced concepts of regression analysis as it applies to empirical social science research. The prime learning objective is to understand different approaches of secondary data analysis, where and how to apply particular econometric estimators, and their limitations. Particular emphasis will be placed on identifying exogenous sources of variation and methods for identifying causal relationships between variables. The class will also cover some of the opportunities and pitfalls associated with the analysis of "big data", drawing on current examples and available data. Textbook-based lectures ensure the transmission of the necessary knowledge. Exercises in class further promote the students' capacity to differentiate and debate the merits of alternative econometric techniques for testing particular hypotheses.</p> <p>This module aims at consolidating students' command of econometrics and related statistical techniques. A command of econometrics constitutes an important fundament for undergraduate studies in the fields of</p>				

economics and helps students to critically appraise scientific statements about causality in many situations, including professional settings. This module helps students to assess and criticize econometric findings in academic papers and promotes their capacity to differentiate between bias and statistical precision in interpreting their own econometric results.

Intended Learning Outcomes

By the end of this module, students will be able to

1. identify the econometric method appropriate to specific data types;
2. implement the method using R-software and interpret the results;
3. design a research project that applies an econometric model to secondary data;
4. write a term paper that develops a thesis, derives a testable hypothesis, presents results, and draws conclusions;
5. articulate model results in terms that a lay person can understand;
6. discriminate between the notions of “economic significance” and “statistical significance”.

Indicative Literature

Angrist, J. D., Pischke, J. S. (2014). *Mastering metrics: The path from cause to effect*. Princeton University Press.

Antonakis, J., Bendahan, S., Jacquart, P. Lalive, R. (2010). On making causal claims: A review and recommendations. *The Leadership Quarterly*, 21(6): 1086-1120.

Usability and Relationship to other Modules

- This module builds on the second-year methods module “Econometrics”, as well as on models and topics from the first-year modules “Microeconomics” and “Macroeconomics” and from the second-year modules “Environmental and Resource Economics” and “Development Economics”. The module expands students’ understandings of econometrics beyond the introductory level towards advanced techniques and applications.

Examination Type: Module Examination

Assessment Type: Term Paper

Length: 2.500 words

Weight: 100%

Scope: All intended learning outcomes of the module

Completion: To pass this module, the assessment has to be passed with at least 45%.

6.18 Financial Data Analytics

Module Name		Module Code	Level (type)	CP
Financial Data Analytics		XXX	Year 3 (Specialization)	5
Module Components				
<i>Number</i>	<i>Name</i>		<i>Type</i>	<i>CP</i>
XXX	Financial Data Analytics		Seminar	5
Module Coordinator	Program Affiliation		Mandatory Status	
Prof. Dr. Andreas Seebeck	<ul style="list-style-type: none"> Management, Decisions and Data Analytics (MDDA) 		Mandatory elective for IBA, GEM, and MDDA	
Entry Requirements			Frequency	Forms of Learning and Teaching
<i>Pre-requisites</i>	<i>Co-requisites</i>	<i>Knowledge, Abilities, or Skills</i>	Annually (Fall)	<ul style="list-style-type: none"> Seminar (35 hours) Private Studies (90 hours)
<input checked="" type="checkbox"/> Major in MDDA, IBA or GEM	<input checked="" type="checkbox"/> none	<ul style="list-style-type: none"> Basic Concepts of Accounting and Finance 	Duration	
			1 semester	125 hours
Recommendations for Preparation				
Students are expected to refresh their knowledge obtained from the module "Introduction to Finance and Accounting". Particularly, they should be able to create and explain the income statement, balance sheet, and statement of cash flows. Moreover, they should be able to perform time value of money calculations.				
Content and Educational Aims				
The module aims to allow participants to analyze financial and non-financial disclosure of corporations from around the world and to show the links between accounting statements, valuation methods and investment analysis.				
Students will learn to extract information from structured and unstructured financial statements. For instance, they will learn how to use the SEC EDGAR website and other databases for financial statement analysis purposes. Next, they will gain experience in analyzing financial data using modern data and text mining approaches and statistical methods. Throughout the course, students will gain hands-on experience in the use of data and text mining approaches to analyze real world financial problems.				
Finally, students will gain an understanding of the limitations of financial statement analysis and the methods for evaluating the quality of financial statements.				
Intended Learning Outcomes				
By the end of this module, students should be able to				
<ol style="list-style-type: none"> calculate and use accounting ratios extract decision-relevant information from quantitative and qualitative disclosure conduct an analysis of corporate strategy and link this to the company's financial performance. 				

4. identify and apply the tools of financial statement analysis, including appropriate technology
5. integrate and apply finance and accounting concepts for valuation analysis, including appropriate technology
6. apply a set of diagnostics to assess the quality of the accounting in financial statements

Indicative Literature

Subramanyam, K. R. (2014). Financial statement analysis. Không nhà xuất bản.

Yam, P., Cheung, K. C., Fan, K., & Chen, Y. (2023). Financial Data Analytics with Machine Learning, Optimization and Statistics. United Kingdom: Wiley.

Ou, J. A., & Penman, S. H. (1989). Financial statement analysis and the prediction of stock returns. Journal of Accounting and Economics, 11(4), 295-329.

Usability and Relationship to other Modules

Examination Type: Module Examination

Assessment Type: Term paper

Length: 2500 words

Weight: 100%

Scope: All intended learning outcomes of the module.

Completion: To pass this module, the assessment has to be passed with at least 45%.

6.19 Internship / Startup and Career Skills

Module Name		Module Code	Level (type)	CP
Internship / Startup and Career Skills		CA-INT-900	Year 3 (CAREER)	15
Module Components				
Number	Name	Type	CP	
CA-INT-900-0	Internship	Internship	15	
Module Coordinator	Program Affiliation	Mandatory Status		
Sinah Vogel & Dr. Tanja Woebs (SCS Organization); SPC / Faculty Startup Coordinator (Academic responsibility)	<ul style="list-style-type: none"> CAREER module for undergraduate study programs 	Mandatory for all undergraduate study programs except IEM		
Entry Requirements		Frequency	Forms of Learning and Teaching	
Pre-requisites	Co-requisites	Annually (Spring/Fall)	<ul style="list-style-type: none"> Internship/Start-up Internship event Seminars, info-sessions, workshops and career events Self-study, readings, online tutorials 	
<input checked="" type="checkbox"/> at least 15 CP from CORE modules in the major	<input checked="" type="checkbox"/> None			
Knowledge, Abilities, or Skills		Duration	Workload	
<ul style="list-style-type: none"> Information provided on SCS pages (see below) Major specific knowledge and skills 		1 semester	375 Hours consisting of: <ul style="list-style-type: none"> Internship (308 hours) Workshops (33 hours) Internship Event (2 hours) Self-study (32 hours) 	
Recommendations for Preparation				
<ul style="list-style-type: none"> Please see the section "Knowledge Center" at JobTeaser Career Center for information on Career Skills seminar and workshop offers and for online tutorials on the job market preparation and the application process. For more information, please see https://www.jacobs-university.de/employability/career-services Participating in the internship events of earlier classes 				
Content and Educational Aims				
<p>The aims of the internship module are reflection, application, orientation, and development: for students to reflect on their interests, knowledge, skills, their role in society, the relevance of their major subject to society, to apply these skills and this knowledge in real life whilst getting practical experience, to find a professional orientation, and to develop their personality and in their career. This module supports the programs' aims of preparing students for gainful, qualified employment and the development of their personality.</p> <p>The full-time internship must be related to the students' major area of study and extends lasts a minimum of two consecutive months, normally scheduled just before the 5th semester, with the internship event and submission of the internship report in the 5th semester. Upon approval by the SPC and CSC, the internship may take place at other times, such as before teaching starts in the 3rd semester or after teaching finishes in the 6th semester. The Study Program Coordinator or their faculty delegate approves the intended internship a priori by reviewing the tasks in either the Internship Contract or Internship Confirmation from the respective internship institution or company. Further regulations as set out in the Policies for Bachelor Studies apply.</p> <p>Students will be gradually prepared for the internship in semesters 1 to 4 through a series of mandatory information sessions, seminars, and career events.</p> <p>The purpose of the Career Services Information Sessions is to provide all students with basic facts about the job market in general, and especially in Germany and the EU, and services provided by the Career Services Center.</p>				

In the Career Skills Seminars, students will learn how to engage in the internship/job search, how to create a competitive application (CV, Cover Letter, etc.), and how to successfully conduct themselves at job interviews and/or assessment centers. In addition to these mandatory sections, students can customize their skill set regarding application challenges and their intended career path in elective seminars.

Finally, during the Career Events organized by the Career Services Center (e.g. the annual Constructor Career Fair and single employer events on and off campus), students will have the opportunity to apply their acquired job market skills in an actual internship/job search situation and to gain their desired internship in a high-quality environment and with excellent employers.

As an alternative to the full-time internship, students can apply for the StartUp Option. Following the same schedule as the full-time internship, the StartUp Option allows students who are particularly interested in founding their own company to focus on the development of their business plan over a period of two consecutive months. Participation in the StartUp Option depends on a successful presentation of the student's initial StartUp idea. This presentation will be held at the beginning of the 4th semester. A jury of faculty members will judge the student's potential to realize their idea and approve the participation of the students. The StartUp Option is supervised by the Faculty StartUp Coordinator. At the end of StartUp Option, students submit their business plan. Further regulations as outlined in the Policies for Bachelor Studies apply.

The concluding Internship Event will be conducted within each study program (or a cluster of related study programs) and will formally conclude the module by providing students the opportunity to present on their internships and reflect on the lessons learned within their major area of study. The purpose of this event is not only to self-reflect on the whole internship process, but also to create a professional network within the academic community, especially by entering the Alumni Network after graduation. It is recommended that all three classes (years) of the same major are present at this event to enable networking between older and younger students and to create an educational environment for younger students to observe the "lessons learned" from the diverse internships of their elder fellow students.

Intended Learning Outcomes

By the end of this module, students should be able to

- describe the scope and the functions of the employment market and personal career development;
- apply professional, personal, and career-related skills for the modern labor market, including self-organization, initiative and responsibility, communication, intercultural sensitivity, team and leadership skills, etc.;
- independently manage their own career orientation processes by identifying personal interests, selecting appropriate internship locations or start-up opportunities, conducting interviews, succeeding at pitches or assessment centers, negotiating related employment, managing their funding or support conditions (such as salary, contract, funding, supplies, work space, etc.);
- apply specialist skills and knowledge acquired during their studies to solve problems in a professional environment and reflect on their relevance in employment and society;
- justify professional decisions based on theoretical knowledge and academic methods;
- reflect on their professional conduct in the context of the expectations of and consequences for employers and their society;
- reflect on and set their own targets for the further development of their knowledge, skills, interests, and values;
- establish and expand their contacts with potential employers or business partners, and possibly other students and alumni, to build their own professional network to create employment opportunities in the future;
- discuss observations and reflections in a professional network.

Indicative Literature

Not specified

Usability and Relationship to other Modules

- This module applies skills and knowledge acquired in previous modules to a professional environment and provides an opportunity to reflect on their relevance in employment and society. It may lead to thesis topics.

Examination Type: Module Examination

Assessment Type: Internship Report or Business Plan and Reflection

Length: approx. 3.500 words

Scope: All intended learning outcomes

Weight: 100%

6.20 Bachelor Thesis and Seminar

Module Name		Module Code	Level (type)	ECTS
Bachelor Thesis and Seminar		CA-MDDA-800	Year 3 (CAREER)	15
Module Components				
Number	Name	Type		ECTS
CA-MDDA-800-T	Thesis	Thesis		12
CA-MDDA-800-S	Thesis Seminar	Seminar		3
Module Coordinator	Program Affiliation		Mandatory Status	
Study Program Chair	<ul style="list-style-type: none"> all Bachelor Programs 		Mandatory for all Bachelor Programs	
Entry Requirements		Frequency	Forms of Learning and Teaching	
Pre-requisites	Co-requisites	Knowledge, Abilities, or Skills	annually	<ul style="list-style-type: none"> Self-study/lab work (350 hours) Seminars (25 hours)
<input checked="" type="checkbox"/> Students must have taken and successfully passed a total of at least 30 CP from advanced modules, and of those, at least 20 CP from advanced modules in the major	<input checked="" type="checkbox"/> None	<ul style="list-style-type: none"> Comprehensive knowledge of the subject and deeper insight into the chosen topic; ability to plan and undertake work independently; skills to identify and critically review literature. 	Duration	Workload
			14-week lecture period	375 hours
Recommendations for Preparation				
<ul style="list-style-type: none"> Identify an area or a topic of interest and discuss this with your prospective supervisor in good time. Create a research proposal including a research plan to ensure timely submission. Ensure you possess all required technical research skills or are able to acquire them on time. Review again the University's Code of Academic Integrity and Guidelines to Ensure Good Academic Practice. 				

Content and Educational Aims

This module is a mandatory graduation requirement for all undergraduate students to demonstrate their ability to deal with a problem from their respective major subject independently by means of academic/scientific methods within a set period. Although supervised, the module requires the student to be able to work independently and regularly and set their own goals in exchange for the opportunity to explore a topic that excites and interests them personally and which a faculty member is interested to supervise. Within this module, students apply their acquired knowledge about the major discipline, skills, and methods to conduct research, ranging from the identification of suitable (short-term) research projects, preparatory literature searches, the realization of discipline-specific research, and the documentation, discussion, interpretation and communication of the results.

This module consists of two components, an independent thesis and an accompanying seminar. The thesis component must be supervised by a Constructor University faculty member and requires short-term research work, the results of which must be documented in a comprehensive written thesis including an introduction, a justification of the methods, results, a discussion of the results, and conclusions. The seminar provides students with the opportunity to present, discuss and justify their and other students' approaches, methods and results at various stages of their research to practice these skills to improve their academic writing, receive and reflect on formative feedback, thereby growing personally and professionally.

Intended Learning Outcomes

On completion of this module, students will be able to

1. independently plan and organize advanced learning processes;
2. design and implement appropriate research methods taking full account of the range of alternative techniques and approaches;
3. collect, assess and interpret relevant information;
4. draw scientifically founded conclusions that consider social, scientific and ethical insights;
5. apply their knowledge and understanding to a context of their choice;
6. develop, formulate and advance solutions to problems and arguments in their subject area, and defend these through argument;
7. discuss information, ideas, problems and solutions with specialists and non-specialists;

Usability and Relationship to other Modules

- This module builds on all previous modules of the program. Students apply the knowledge, skills and competencies they acquired and practiced during their studies, including research methods and the ability to acquire additional skills independently as and if required.

Examination Type: Module Component Examination

Module Component 1: Thesis

Length: approx. 6.000–8.000 words

(15–25 pages), excluding front- and back matter.

Scope: All intended learning outcomes, mainly 1-6.

Weight: 80%

Module Component 2: Seminar

Type: Presentation

Duration: approx. 15 to 30 minutes

Weight: 20%

Scope: The presentation focusses mainly on ILOs 6 and 7, but by nature of these ILOs also touches on the others.

Two separate assessments are justified by the size of the module and the fact that the justification of solutions to problems and arguments (ILO 6) and discussion (ILO 7) should at least have verbal elements. The weights of the assessments are commensurate with the sizes of the respective module components.

7 Constructor Track Modules

7.1 Methods

7.1.1 Applied Calculus

Module Name Applied Calculus			Module Code JTMS-MAT-08	Level (type) Year 1 (Methods)	CP 5
Module Components					
Number	Name				Type
JTMS-08	Applied Calculus				Lecture 5
Module Coordinator	Program Affiliation			Mandatory Status	
N.N.	<ul style="list-style-type: none"> Constructor Track Area 			Mandatory for GEM, IBA, MDDA and IEM	
Entry Requirements				Frequency	Forms of Learning and Teaching
Pre-requisites	Co-requisites	Knowledge, Abilities, or Skills		Annually (Fall)	<ul style="list-style-type: none"> Lectures (35 hours) Private study (90 hours)
<input checked="" type="checkbox"/> None	<input checked="" type="checkbox"/> None	<ul style="list-style-type: none"> Knowledge of Mathematics at high school level (Functions, graphs of functions, linear and polynomial functions, logarithms and exponential function, basic trigonometric functions, elementary methods for solving systems of linear and nonlinear equations) Some familiarity with elementary calculus (limits, derivatives) is helpful, but not required. 		Duration 1 semester	
Workload 125 hours					
Recommendations for Preparation					
None.					
Content and Educational Aims					
<p>This module is an introduction to Calculus for students in life sciences, applied engineering, humanities and social science majors. It gives a broad overview of the methods of Calculus, putting more emphasis on applications, rather than on mathematical rigor. Most of the concepts and methods are backed up by examples from chemistry, biology, economics and/or other sciences. In this module students enhance both their quantitative problem-solving skills as well as their conceptual understanding of mathematical methods.</p> <p>The lecture comprises the following topics:</p> <ul style="list-style-type: none"> Brief review of elementary functions and their graphs Intuitive understanding of limits; horizontal and vertical asymptotes 					

- Derivatives and their computation
- Applications of derivatives (interpretation of derivatives, their units, local linear approximation, error propagation, optimization problems)
- Brief introduction to functions of several variables, partial derivatives, local minima and maxima
- Integrals and their computation
- Applications of integrals (accumulated change, average value, applications in probability: density functions and cumulative distribution functions)
- Brief introduction to differential equations.

Intended Learning Outcomes

By the end of the module, students will be able to

1. apply the fundamental concepts of Calculus in structured situations;
2. command the methods described in the content section of this module description to the extent that they can solve standard text-book problems reliably and with confidence;
3. explain importance of the methods of Calculus in problems arising from applications;
4. understand the methods of Calculus, used in other modules, as well as in scientific literature.

Indicative Literature

D. Hughes-Hallett, A. Gleason, P. Lock, D. Flath, et al. (2010/2013). Applied Calculus, 4th or 5th edition. Hoboken: Wiley.

Usability and Relationship to other Modules

- The module serves as preparation for the 2nd year IEM CORE module Operations Research.
- This serves as preparation for the 1st year GEM and IBA modules Microeconomics, Macroeconomics and Introduction to Finance and Accounting
- A mathematically rigorous treatment of Calculus is provided in the module "Analysis I".
- The first year modules *Calculus and Elements of Linear Algebra I+II* can be used in place of the modules *Applied Calculus* and *Finite Mathematics*, respectively, to satisfy the graduation requirements in majors in which they are mandatory.

Examination Type: Module Examination

Assessment type: Written examination

Duration: 120 min

Weight: 100%

Scope: All intended learning outcomes of this module

Completion: To pass this module, the assessment has to be passed with at least 45%.

7.1.2 Applied Statistics with R

Module Name Applied Statistics with R		Module Code CTMS-MET-03	Level (type) Year 1/2 (Methods)	CP 5
Module Components				
<i>Number</i>	<i>Name</i>	<i>Type</i>		<i>CP</i>
CMTS-03	Applied Statistics with R	Lecture & Lab		5
Module Coordinator	Program Affiliation		Mandatory Status	
Prof. Dr. Adalbert F.X. Wilhelm	<ul style="list-style-type: none"> Constructor Track area 		Mandatory for ESSMER, MDDA, GEM and IEM, Mandatory elective for SMP, IBA, ISCP, IRPH	
Entry Requirements			Frequency	Forms of Learning and Teaching
<i>Pre-requisites</i>	<i>Co-requisites</i>	<i>Knowledge, Abilities, or Skills</i>	Annually (Spring)	<ul style="list-style-type: none"> Lecture (17.5 hours) Lab (17.5 hours) Homework and self-study (90 hours)
<input checked="" type="checkbox"/> None	<input checked="" type="checkbox"/> None	<ul style="list-style-type: none"> none 		
			Duration	Workload
			1 semester	125 hours
Recommendations for Preparation				
Get acquainted to statistical thinking by watching online videos for introductory probability and statistics as well as paying attention whenever arguments are backed up by empirical data.				
Content and Educational Aims				
<p>We live in a world full of data and more and more decisions are taken based on a comprehensive analysis of data. A central method of data analysis is the use of models describing the relationship between a set of predictor variables and a response. This module provides a thorough introduction to quantitative data analysis covering graphical representations, numerical summary statistics, correlation, and regression models. The module also introduces the fundamental concepts of statistical inference. Students learn about the different data types, how to best visualize them and how to draw conclusions from the graphical representations. Students will learn in this module the ideas and techniques of regression models within the generalized linear model framework involving multiple predictors and co-variates. Students will learn how to become an intelligent user of statistical techniques from a consumers perspective to assess the quality of presented statistical results and to produce high-quality analyses by themselves. By using illustrative examples from economics, engineering, and the natural and social sciences students will gain the relevant background knowledge for their specific major as well as an interdisciplinary glimpse of other research fields. The general objective of the module is to enable students to become skilled statistical modelers who are well versed in the various assumptions, limitations, and controversies of statistical models and their application. Regular exercises and practical sessions will corroborate the students' proficiency with the statistical software R.</p>				
Intended Learning Outcomes				
By the end of this module, students should be able to:				
<ol style="list-style-type: none"> apply basic techniques in statistical modeling and quantitative research methods describe fundamental statistical concepts, procedures, their assumptions and statistical fallacies explain the potential of using quantitative methods in all fields of applications; express informed skepticism of the limitations of statistical reasoning; interpret statistical modeling results in scientific publications; perform basic and intermediate-level statistical analyses of data, using R. 				

Indicative Literature

Michael J. Crawley (2013). The R Book, Second Edition. Hoboken: John Wiley & Sons.

Peter Daalgard (2008). Introductory Statistics with R. Berlin: Springer.

John Maindonald, W. John Braun (2010). Data Analysis and Graphics Using R – an Example-Based Approach, Third Edition, Cambridge Series. In *Statistical and Probabilistic Mathematics*. Cambridge: Cambridge University Press.

Christopher Gandrud (2015). Reproducible Research with R and RStudio, Second Edition. The R Series, Chapman & Hall/CRC Press.

Randall E. Schumacker (2014). Learning Statistics Using R. Thousand Oaks: Sage.

Charles Wheelan (2013). Naked Statistics: Stripping the Dread from The Data. New York: W.W. Norton & Company.

Usability and Relationship to other Modules

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Examination Type: Module Examination

Assessment Type: Written examination

Duration: 120 min

Weight: 100%

During the examination students use the software R as an auxiliary resource approved by the Instructor of Record.

Scope: All intended learning outcomes of the module.

Completion: To pass this module, the assessment has to be passed with at least 45%.

7.1.3 Marketing & Methods

Module Name Marketing & Methods		Module Code CTMS-MET-20	Level (type) Year 2 (Methods)	CP 5
Module Components				
<i>Number</i>	<i>Name</i>	<i>Type</i>	<i>CP</i>	
CTMS-20	Marketing & Methods	Lecture	5	
Module Coordinator N.N.	Program Affiliation <ul style="list-style-type: none"> Constructor Track area 		Mandatory Status Mandatory for MDDA	
Entry Requirements		Frequency Annually (Fall)	Forms of Learning and Teaching	
<i>Pre-requisites</i>	<i>Co-requisites</i>	<i>Knowledge, Abilities, or Skills</i>	<ul style="list-style-type: none"> Lecture (80 hours) Private study (45 hours) 	
<input checked="" type="checkbox"/> None	<input checked="" type="checkbox"/> None			
		Duration 1 semester	Workload 125 hours	
Recommendations for Preparation N.A.				
Content and Educational Aims				
<p>This module is focused on key aspects of marketing and its methodologies used in today's marketing practice. State-of-the-art methods including the usage of data and approaches will be at the core of the module.</p> <p>The overall goal of this module is to help students without prior marketing knowledge to learn, understand and practice the fundamentals of applied marketing methodology. This module helps students to understand today's marketing challenges in a complex world, where unpredictable is common, and where managers need to focus on achieving goals rather than repetitive tasks. Students learn to develop and present consumer-centered and theory-based solutions for real-world marketing challenges.</p> <p>Major challenges and concerns will be reflected:</p> <ul style="list-style-type: none"> the role of the customer and data in a transformed business world state-of-the-art methods and marketing techniques ethics and security issues. 				
Intended Learning Outcomes				
<p>Upon completion of this module, students will be able to:</p> <ol style="list-style-type: none"> Develop practical knowledge and marketing skills, and mind sets to master the challenges of today's markets Understand (routine) marketing processes in various context and how to state-of-the art methodology to inform marketing decisions Summarize and classify the new data- and customer-driven methodologies in a marketing context Understand the idea and potential for value-creation of consumer-centricity Apply innovative creativity methods and processes for marketing 				
Indicative Literature				
<ul style="list-style-type: none"> Kotler, Keller, Chernev (2021): Marketing Management, Global Edition, 16th edition 				

Usability and Relationship to other Modules

Examination Type: Module Examination

Assessment Type: Presentation

Duration: 30 min

Weight: 100%

Scope: All intended learning outcomes.

Completion: To pass this module, the assessment has to be passed with at least 45%.

7.1.4 Econometrics

Module Name Econometrics		Module Code JTMS-MET-05	Level (type) Year 2 (Methods)	CP 5
Module Components				
Number	Name	Type		CP
JTMS-05	Econometrics	Seminar		5
Module Coordinator Prof. Dr. Colin Vance	Program Affiliation • Constructor Track Area		Mandatory Status Mandatory for GEM, MDDA Mandatory elective for IBA	
Entry Requirements		Frequency	Forms of Learning and Teaching	
Pre-requisites	Co-requisites	Knowledge, Abilities, or Skills	Annually (Spring)	<ul style="list-style-type: none"> Seminar (35 hours) Private study (90 hours)
<input checked="" type="checkbox"/> Applied statistics with R	<input checked="" type="checkbox"/> None	<ul style="list-style-type: none"> Knowledge of the ordinary least-squares regression model. Ability to estimate regression models using R software. Skills in conducting statistical inference tests. 	Duration 1 semester	
Recommendations for Preparation				
<p>An accessible overview of regression analysis can be found in Sykes, A.O. (1993). An Introduction to Regression Analysis. Coase-Sandor Institute for Law & Economics, Univ. of Chicago Working Paper No. 20. https://chicagounbound.uchicago.edu/law_and_economics/51/. Students are also encouraged to read: Ziliak, Stephen T. (2008). Retrospectives: Guinnessometrics: The Economic Foundation of "Student's" t. <i>Journal of Economic Perspectives</i> 22(4): 199-216.</p>				
Content and Educational Aims				
<p>This module focuses on the application of econometric methods to the analysis of secondary data. Specifically, the goal is to expose students to some of the issues and challenges typically confronted by econometricians when analyzing empirical data in the realms of social science research, business and finance. Emphasis will be placed on the intuition underlying various commonly applied econometric techniques and on the steps needed to implement them. The module expands on the knowledge acquired in statistics and intensifies discussions of multiple regression analysis. The general objective is to become familiar with contemporary methods that are used in econometric and business analyses and to become a critical reader of case studies. In this regard, a clear distinction will be drawn along two dimensions: between questions of statistical significance versus those of economic or social significance; and between correlation and causation. The module takes a practical approach that covers how to estimate econometric models using R software. Sessions will often include computer applications to foster understanding of the discussed topics.</p>				
Intended Learning Outcomes				
<p>By the end of this module, students should be able to:</p> <ol style="list-style-type: none"> explain the mechanics and assumptions underpinning the Ordinary Least Squares (OLS) regression model; estimate an OLS model on secondary data using R-software; interpret the coefficient estimates from an OLS model with respect to their sign and magnitude; conduct one- and two-sided tests of the statistical significance of coefficients. 				

Indicative Literature

Abadie, A. & Cattaneo, M.D. (2018). Econometric methods for program evaluation. *Annual Review of Economics*, 10, 465-503.

Angrist, J.D. & Pischke, J.S. (2014). *Mastering'metrics: The path from cause to effect*. Princeton University Press.

Kabacoff, R. (2015). *R in action: Data analysis and graphics with R*. Chapter 8. Manning Publications Co.

Wooldridge, J. M. (2015). *Introductory econometrics: A modern approach*. 6th edition. Cambridge Learning.

Ziliak, Stephen T. (2008). Guinnessometrics: The economic foundation of "student's". *Journal of Economic Perspectives* 22(4), 199-216.

Usability and Relationship to other Modules

- This module builds on models and topics from the first-year modules "Microeconomics" and "Macroeconomics" and from the second-year modules "Environmental and Resource Economics" and "Development Economics"
- This module introduces students to R in preparation for the 2nd year mandatory method module on econometrics and 3rd year GEM module on advanced econometrics; the statistics skills prepare students for all 2nd and 3rd year GEM modules and the thesis
- This module prepares students in IBA for the analysis of data in the 2nd year modules International Strategic Management and Marketing and the 3rd year module Contemporary Topics in Marketing and the thesis

Examination Type: Module Examination

Assessment type: Written examination

Duration: 120 min

Weight: 100%

Scope: All intended learning outcomes of the module.

Completion: To pass this module, the assessment has to be passed with at least 45%.

7.2 New Skills

7.2.1 Logic (perspective I)

Module Name Logic (perspective I)		Module Code CTNS-NSK-01	Level (type) Year 2 (New Skills)	CP 2.5
Module Components				
<i>Number</i>	<i>Name</i>	<i>Type</i>	<i>CP</i>	
CTNS-01	Logic (perspective I)	Lecture (online)	2.5	
Module Coordinator Prof. Jules Coleman	Program Affiliation <ul style="list-style-type: none"> Constructor Track Area 		Mandatory Status Mandatory elective for all UG students (one perspective must be chosen)	
Entry Requirements		Frequency	Forms of Learning and Teaching	
<i>Pre-requisites</i>	<i>Co-requisites</i>	Annually (Fall)	Online lecture (17.5h) Private study (45h)	
<input checked="" type="checkbox"/> none	<input checked="" type="checkbox"/> none			
		Duration	Workload	
		1 semester	62.5 hours	
Recommendations for Preparation				
Content and Educational Aims				
<p>Suppose a friend asks you to help solve a complicated problem? Where do you begin? Arguably, the first and most difficult task you face is to figure out what the heart of the problem actually is. In doing that you will look for structural similarities between the problem posed and other problems that arise in different fields that others may have addressed successfully. Those similarities may point you to a pathway for resolving the problem you have been asked to solve. But it is not enough to look for structural similarities. Sometimes relying on similarities may even be misleading. Once you've settled tentatively on what you take to be the heart of the matter, you will naturally look for materials, whether evidence or arguments, that you believe is relevant to its potential solution. But the evidence you investigate of course depends on your formulation of the problem, and your formulation of the problem likely depends on the tools you have available – including potential sources of evidence and argumentation. You cannot ignore this interactivity, but you can't allow yourself to be hamstrung entirely by it. But there is more. The problem itself may be too big to be manageable all at once, so you will have to explore whether it can be broken into manageable parts and if the information you have bears on all or only some of those parts. And later you will face the problem of whether the solutions to the particular sub problems can be put together coherently to solve the entire problem taken as a whole.</p> <p>What you are doing is what we call engaging in computational thinking. There are several elements of computational thinking illustrated above. These include: Decomposition (breaking the larger problem down into smaller ones); Pattern recognition (identifying structural similarities); Abstraction (ignoring irrelevant particulars of the problem): and Creating Algorithms), problem-solving formulas.</p> <p>But even more basic to what you are doing is the process of drawing inferences from the material you have. After all, how else are you going to create a problem-solving formula, if you draw incorrect inferences about what information has shown and what, if anything follows logically from it. What you must do is apply the rules of logic to the information to draw inferences that are warranted.</p> <p>We distinguish between informal and formal systems of logic, both of which are designed to indicate fallacies as well as warranted inferences. If I argue for a conclusion by appealing to my physical ability to coerce you, I prove</p>				

nothing about the truth of what I claim. If anything, by doing so I display my lack of confidence in my argument. Or if the best I can do is berate you for your skepticism, I have done little more than offer an ad hominem instead of an argument. Our focus will be on formal systems of logic, since they are at the heart of both scientific argumentation and computer developed algorithms. There are in fact many different kinds of logic and all figure to varying degrees in scientific inquiry. There are inductive types of logic, which purport to formalize the relationship between premises that if true offer evidence on behalf of a conclusion and the conclusion and are represented as claims about the extent to which the conclusion is confirmed by the premises. There are deductive types of logic, which introduce a different relationship between premise and conclusion. These variations of logic consist in rules that if followed entail that if the premises are true then the conclusion too must be true.

There are also modal types of logic which are applied specifically to the concepts of necessity and possibility, and thus to the relationship among sentences that include either or both those terms. And there is also what are called deontic logic, a modification of logic that purport to show that there are rules of inference that allow us to infer what we ought to do from facts about the circumstances in which we find ourselves. In the natural and social sciences most of the emphasis has been placed on inductive logic, whereas in math it is placed on deductive logic, and in modern physics there is an increasing interest in the concepts of possibility and necessity and thus in modal logic. The humanities, especially normative discussions in philosophy and literature are the province of deontic logic.

This module will also take students through the central aspects of computational thinking, as it is related to logic; it will introduce the central concepts in each, their relationship to one another and begin to provide the conceptual apparatus and practical skills for scientific inquiry and research.

Intended Learning Outcomes

Students acquire transferable and key skills in this module.

By the end of this module, the students will be able to:

1. apply the various principles of logic and expand them to computational thinking.
2. understand the way in which logical processes in humans and in computers are similar and different at the same time.
3. apply the basic rules of first-order deductive logic and employ them rules in the context of creating a scientific or social scientific study and argument.
4. employ those rules in the context of creating a scientific or social scientific study and argument.

Indicative Literature

Frege, Gottlob (1879), Begriffsschrift, eine der arithmetischen nachgebildete Formelsprache des reinen Denkens [Translation: A Formal Language for Pure Thought Modeled on that of Arithmetic], Halle an der Salle: Verlag von Louis Nebert.

Gödel, Kurt (1986), Russels mathematische Logik. In: Alfred North Whitehead, Bertrand Russell: Principia Mathematica. Vorwort, S. V-XXXIV. Suhrkamp.

Leeds, Stephen. "George Boolos and Richard Jeffrey. Computability and logic. Cambridge University Press, New York and London 1974, x+ 262 pp." The Journal of Symbolic Logic 42.4 (1977): 585-586.

Kubica, Jeremy. Computational fairy tales. Jeremy Kubica, 2012.

McCarthy, Timothy. "Richard Jeffrey. Formal logic: Its scope and limits. of XXXVIII 646. McGraw-Hill Book Company, New York etc. 1981, xvi+ 198 pp." The Journal of Symbolic Logic 49.4 (1984): 1408-1409.

Usability and Relationship to other Modules

Examination Type: Module Examination

Assessment Type: Written Examination

Duration/Length: 60 min

Weight: 100%

Scope: All intended learning outcomes of the module.

Completion: To pass this module, the assessment has to be passed with at least 45%.

7.2.2 Logic (perspective II)

Module Name Logic (perspective II)		Module Code CTNS-NSK-02	Level (type) Year 2 (New Skills)	CP 2.5
Module Components				
Number	Name	Type	CP	
CTNS-02	Logic (perspective II)	Lecture (online)	2.5	
Module Coordinator N.N.	Program Affiliation <ul style="list-style-type: none"> Constructor Track Area 		Mandatory Status Mandatory elective for all UG students (one perspective must be chosen)	
Entry Requirements		Frequency	Forms of Learning and Teaching	
Pre-requisites <input checked="" type="checkbox"/> none	Co-requisites <input checked="" type="checkbox"/> none	Annually (Fall)	Online lecture (17.5h) Private study (45h)	
Knowledge, Abilities, or Skills •		Duration 1 semester	Workload 62.5 hours	
Recommendations for Preparation				
Content and Educational Aims				
<p>The focus of this module is on formal systems of logic, since they are at the heart of both scientific argumentation and computer developed algorithms. There are in fact many kinds of logic and all figure to varying degrees in scientific inquiry. There are inductive types of logic, which purport to formalize the relationship between premises that if true offer evidence on behalf of a conclusion and the conclusion and are represented as claims about the extent to which the conclusion is confirmed by the premises. There are deductive types of logic, which introduce a different relationship between premise and conclusion. These variations of logic consist in rules that if followed entail that if the premises are true then the conclusion too must be true.</p> <p>This module introduces logics that go beyond traditional deductive propositional logic and predicate logic and as such it is aimed at students who are already familiar with basics of traditional formal logic. The aim of the module is to provide an overview of alternative logics and to develop a sensitivity that there are many different logics that can provide effective tools for solving problems in specific application domains.</p> <p>The module first reviews the principles of a traditional logic and then introduces many-valued logics that distinguish more than two truth values, for example true, false, and unknown. Fuzzy logic extends traditional logic by replacing truth values with real numbers in the range 0 to 1 that are expressing how strong the believe into a proposition is. Modal logics introduce modal operators expressing whether a proposition is necessary or possible. Temporal logics deal with propositions that are qualified by time. Once can view temporal logics as a form of modal logics where propositions are qualified by time constraints. Interval temporal logic provides a way to reason about time intervals in which propositions are true.</p> <p>The module will also investigate the application of logic frameworks to specific classes of problems. For example, a special subset of predicate logic, based on so-called Horn clauses, forms the basis of logic programming languages such as Prolog. Description logics, which are usually decidable logics, are used to model relationships and they have applications in the semantic web, which enables search engines to reason about resources present on the Internet.</p>				
Intended Learning Outcomes				
Students acquire transferable and key skills in this module.				
By the end of this module, the students will be able to:				
<ol style="list-style-type: none"> 1. apply the various principles of logic 2. explain practical relevance of non-standard logic 				

3. describe how many-valued logic extends basic predicate logic
4. apply basic rules of fuzzy logic to calculate partial truth values
5. sketch basic rules of temporal logic
6. implement predicates in a logic programming language
7. prove some simple non-standard logic theorems

Indicative Literature

Bergmann, Merry. "An Introduction to Many-Valued and Fuzzy Logic: Semantics, Algebras, and Derivation Systems", Cambridge University Press, April 2008.

Sterling, Leon S., Ehud Y. Shapiro, Ehud Y. "The Art of Prolog", 2nd edition, MIT Press, March 1994.

Fisher, Michael. "An Introduction to Practical Formal Methods Using Temporal Logic", Wiley, Juli 2011.

Baader, Franz. "The Description Logic Handbook: Theory Implementation and Applications", Cambridge University Press, 2nd edition, May 2010.

Usability and Relationship to other Modules

Examination Type: Module Examination

Assessment Type: Written Examination

Duration/Length: 60 min

Weight: 100%

Scope: All intended learning outcomes of the module.

Completion: To pass this module, the assessment has to be passed with at least 45%.

7.2.3 Causation and Correlation (perspective I)

Module Name Causation and Correlation (perspective I)		Module Code CTNS-NSK-03	Level (type) Year 2 (New Skills)	CP 2.5
Module Components				
<i>Number</i>	<i>Name</i>	<i>Type</i>		<i>CP</i>
CTNS-03	Causation and Correlation	Lecture (online)		2.5
Module Coordinator Prof. Dr. Jules Coleman	Program Affiliation <ul style="list-style-type: none"> Constructor Track Area 		Mandatory Status Mandatory elective for all UG students (one perspective must be chosen)	
Entry Requirements		Frequency	Forms of Learning and Teaching	
<i>Pre-requisites</i> <input checked="" type="checkbox"/> none	<i>Co-requisites</i> <input checked="" type="checkbox"/> none	<i>Knowledge, Abilities, or Skills</i> •	Annually (Spring)	Online lecture (17.5h) Private study (45h)
		Duration	Workload	
		1 semester	62.5 hours	
Recommendations for Preparation				
Content and Educational Aims				
<p>In many ways, life is a journey. And also, as in other journeys, our success or failure depends not only on our personal traits and character, our physical and mental health, but also on the accuracy of our map. We need to know what the world we are navigating is actually like, the how, why and the what of what makes it work the way it does. The natural sciences provide the most important tool we have developed to learn how the world works and why it works the way it does. The social sciences provide the most advanced tools we have to learn how we and other human beings, similar in most ways, different in many others, act and react and what makes them do what they do. In order for our maps to be useful, they must be accurate and correctly reflect the way the natural and social worlds work and why they work as they do.</p> <p>The natural sciences and social sciences are blessed with enormous amounts of data. In this way, history and the present are gifts to us. To understand how and why the world works the way it does requires that we are able to offer an explanation of it. The data supports a number of possible explanations of it. How are we to choose among potential explanations? Explanations, if sound, will enable us to make reliable predictions about what the future will be like, and also to identify many possibilities that may unfold in the future. But there are differences not just in the degree of confidence we have in our predictions, but in whether some of them are necessary future states or whether all of them are merely possibilities? Thus, there are three related activities at the core of scientific inquiry: understanding where we are now and how we got here (historical); knowing what to expect going forward (prediction); and exploring how we can change the paths we are on (creativity).</p> <p>At the heart of these activities are certain fundamental concepts, all of which are related to the scientific quest to uncover immutable and unchanging laws of nature. Laws of nature are thought to reflect a <u>causal</u> nexus between a previous event and a future one. There are also true statements that reflect universal or nearly universal connections between events past and present that are not laws of nature because the relationship they express is that of a <u>correlation</u> between events. A working thermostat accurately allows us to determine or even to predict the temperature in the room in which it is located, but it does not explain why the room has the temperature it has. What then is the core difference between causal relationships and correlations? At the same time, we all recognize that given where we are now there are many possible futures for each of us, and even had our lives gone just the slightest bit differently than they have, our present state could well have been very different than it is. The relationship between possible pathways between events that have not materialized but could have is expressed through the idea of <u>counterfactual</u>.</p>				

Creating accurate roadmaps, forming expectations we can rely on, making the world a more verdant and attractive place requires us to understand the concepts of causation, correlation, counterfactual explanation, prediction, necessity, possibility, law of nature and universal generalization. This course is designed precisely to provide the conceptual tools and intellectual skills to implement those concepts in our future readings and research and ultimately in our experimental investigations, and to employ those tools in various disciplines.

Intended Learning Outcomes

Students acquire transferable and key skills in this module.

By the end of this module, the students will be able to:

1. formulate testable hypotheses that are designed to reveal causal connections and those designed to reveal interesting, important and useful correlations.
2. distinguish scientifically interesting correlations from unimportant ones.
3. apply critical thinking skills to evaluate information.
4. understand when and why inquiry into unrealized possibility is important and relevant.

Indicative Literature

Thomas S. Kuhn: The Structure of Scientific Revolutions, Nelson, fourth edition 2012;

Goodman, Nelson. Fact, fiction, and forecast. Harvard University Press, 1983;

Quine, Willard Van Orman, and Joseph Silbert Ullian. The web of belief. Vol. 2. New York: Random house, 1978.

Usability and Relationship to other Modules

Examination Type: Module Examination

Assessment Type: Written Examination

Duration/Length: 60 min

Weight: 100%

Scope: All intended learning outcomes of the module

Completion: To pass this module, the assessment has to be passed with at least 45%.

7.2.4 Causation and Correlation (perspective II)

Module Name		Module Code	Level (type)	CP
Causation and Correlation (perspective II)		CTNS-NSK-04	Year 2 (New Skills)	2.5
Module Components				
Number	Name	Type		CP
CTNS-04	Causation and Correlations	Lecture (online)		2.5
Module Coordinator	Program Affiliation		Mandatory Status	
Dr. Keivan Mallahi-Karai, Dr. Eoin Ryan, Dr. Irina Chiaburu	<ul style="list-style-type: none"> Constructor Track Area 		Mandatory elective for all UG students (one perspective must be chosen)	
Entry Requirements			Frequency	Forms of Learning and Teaching
<i>Pre-requisites</i>	<i>Co-requisites</i>	<i>Knowledge, Abilities, or Skills</i>	Annually (Spring)	Online lecture (17.5h) Private study (45h)
<input checked="" type="checkbox"/> none	<input checked="" type="checkbox"/> none	<ul style="list-style-type: none"> Basic probability theory 		
			Duration	Workload
			1 semester	62.5 hours
Recommendations for Preparation				
Content and Educational Aims				
<p>Causality or causation is a surprisingly difficult concept to understand. David Hume famously noted that causality is a concept that our science and philosophy cannot do without, but it is equally a concept that our science and philosophy cannot describe. Since Hume, the problem of cause has not gone away, and sometimes seems to get even worse (e.g., quantum mechanics confusing previous notions of causality). Yet, ways of doing science that lessen our need to explicitly use causality have become very effective (e.g., huge developments in statistics). Nevertheless, it still seems that the concept of causality is at the core of explaining how the world works, across fields as diverse as physics, medicine, logistics, the law, sociology, and history – and ordinary daily life – through all of which, explanations and predictions in terms of cause and effect remain intuitively central.</p> <p>Causality remains a thorny problem but, in recent decades, significant progress has occurred, particularly in work by or inspired by Judea Pearl. This work incorporates many 20th century developments, including statistical methods – but with a reemphasis on finding the why, or the cause, behind statistical correlations –, progress in understanding the logic, semantics and metaphysics of conditionals and counterfactuals, developments based on insights from the likes of philosopher Hans Reichenbach or biological statistician Sewall Wright into causal precedence and path analysis, and much more. The result is a new toolkit to identify causes and build causal explanations. Yet even as we get better at identifying causes, this raises new (or old) questions about causality, including metaphysical questions about the nature of causes (and effects, events, objects, etc), but also questions about what we really use causality for (understanding the world as it is or just to glean predictive control of specific</p>				

outcomes), about how causality is used differently in different fields and activities (is cause in physics the same as that in history?), and about how other crucial concepts relate to our concept of cause (space and time seem to be related to causality, but so do concepts of legal and moral responsibility).

This course will introduce students to the mathematical formalism derived from Pearl's work, based on directed acyclic graphs and probability theory. Building upon previous work by Reichenbach and Wright, Pearl defines a "a calculus of interventions" of "do-calculus" for talking about interventions and their relation to causation and counterfactuals. This model has been applied in various areas ranging from econometrics to statistics, where acquiring knowledge about causality is of great importance.

At the same time, the course will not forget some of the metaphysical and epistemological issues around cause, so that students can better critically evaluate putative causal explanations in their full context. Abstractly, such issues involve some of the same philosophical questions Hume already asked, but more practically, it is important to see how metaphysical and epistemological debates surrounding the notion of cause affect scientific practice, and equally if not more importantly, how scientific practice pushes the limits of theory. This course will look at various ways in which empirical data can be transformed into explanations and theories, including the *variance* approach to causality (characteristic of the positivistic quantitative paradigm), and the *process* theory of causality (associated with qualitative methodology). Examples and case studies will be relevant for students of the social sciences but also students of the natural/physical world as well.

Intended Learning Outcomes

Students acquire transferable and key skills in this module.

By the end of this module, the students will:

1. have a clear understanding of the history of causal thinking.
2. be able to form a critical understanding of the key debates and controversies surrounding the idea of causality.
3. be able to recognize and apply probabilistic causal models.
4. be able to explain how understanding of causality differs among different disciplines.
5. be able demonstrate how theoretical thinking about causality has shaped scientific practices.

Indicative Literature

Paul, L. A. and Ned Hall. Causation: A User's Guide. Oxford University Press 2013.

Pearl, Judea. Causality: Models, Reasoning and Inference. Cambridge University Press 2009

Pearl, Judea, Glymour Madelyn and Jewell, Nicolas. Causal Inference in Statistics: A Primer. Wiley 2016

Ilari, Phyllis McKay and Federica Russo. Causality: Philosophical Theory Meets Scientific Practice. Oxford University Press 2014.

Usability and Relationship to other Modules

Examination Type: Module Examination

Assessment: Written examination

Duration/Length: 60 min

Weight: 100 %

Scope: All intended learning outcomes of the module

Completion: To pass this module, the assessment has to be passed with at least 45%.

7.2.5 Linear Model and Matrices

Module Name		Module Code	Level (type)	CP
Linear Model and Matrices		CNTS-NSK-05	Year 3 (New Skills)	5
Module Components				
<i>Number</i>	<i>Name</i>		<i>Type</i>	<i>CP</i>
CTNS-05	Linear models and matrix approaches across disciplines		Seminar	5
Module Coordinator	Program Affiliation		Mandatory Status	
Prof. Dr. Marc-Thorsten Hütt	<ul style="list-style-type: none"> Constructor Track Area 		Mandatory elective	
Entry Requirements		Frequency	Forms of Learning and Teaching	
<i>Pre-requisites</i>	<i>Co-requisites</i>	<i>Knowledge, Abilities, or Skills</i>		
<input checked="" type="checkbox"/> Logic	<input checked="" type="checkbox"/> none		Annually (Fall)	Online lecture (35h) Private Study (90h)
<input checked="" type="checkbox"/> Causation & Correlation			Duration	Workload
			1 Semester	125 hours
Recommendations for Preparation				
Content and Educational Aims				
<p>There are no universal 'right skills'. But the notion of linear models and the avenue to matrices and their properties can be useful in diverse disciplines to implement a quantitative, computational approach. Some of the most popular data and systems analysis strategies are built upon this framework. Examples include principal component analysis (PCA), the optimization techniques used in Operations Research (OR), the assessment of stable and unstable states in nonlinear dynamical systems, as well as aspects of machine learning.</p> <p>Here we introduce the toolbox of linear models and matrix-based methods embedded in a wide range of transdisciplinary applications (part 1). We describe its foundation in linear algebra (part 2) and the range of tools and methods derived from this conceptual framework (part 3). At the end of the course, we outline applications to graph theory and machine learning (part 4). Matrices can be useful representations of networks and of system of linear equations. They are also the core object of linear stability analysis, an approach used in nonlinear dynamics. Throughout the course, examples from neuroscience, social sciences, medicine, biology, physics, chemistry, and other fields are used to illustrate these methods.</p> <p>A strong emphasis of the course is on the sensible usage of linear approaches in a nonlinear world. We will critically reflect the advantages as well as the disadvantages and limitations of this method. Guiding questions are: How appropriate is a linear approximation of a nonlinear system? What do you really learn from PCA? How reliable are the optimal states obtained via linear programming (LP) techniques?</p> <p>This debate is embedded in a broader context: How does the choice of a mathematical technique confine your view on the system at hand? How, on the other hand, does it increase your capabilities of analyzing the system</p>				

(due to software available for this technique, the ability to compare with findings from other fields built upon the same technique and the volume of knowledge about this technique)?

In the end, students will have a clearer understanding of linear models and matrix approaches in their own discipline, but they will also see the full transdisciplinarity of this topic. They will make better decisions in their choice of data analysis methods and become mindful of the challenges when going from a linear to a nonlinear thinking.

Intended Learning Outcomes

Upon completion of this module, students will be able to:

1. apply the concept of linear modeling in their own discipline;
2. distinguish between linear and nonlinear interpretation strategies and understand the range of applicability of linear models;
3. make use of data analysis / data interpretation strategies from other disciplines, which are derived from linear algebra;
4. be aware of the ties that linear models have to machine learning and network theory.

Note that these four ILOs can be loosely associated with the four parts of the course indicated above.

Indicative Literature

Part 1:

material from Linear Algebra for Everyone, Gilbert Strang, Wellesley-Cambridge Press, 2020

Part 2:

material from Introduction to Linear Algebra (5th Edition), Gilbert Strang, Cambridge University Press, 2021

Part 3:

Mainzer, Klaus. "Introduction: from linear to nonlinear thinking." Thinking in Complexity: The Computational Dynamics of Matter, Mind and Mankind (2007): 1-16.

material from Mathematics of Big Data: Spreadsheets, Databases, Matrices, and Graphs, Jeremy Kepner, Hayden Jananthan, The MIT Press, 2018

material from Introduction to Linear Algebra (5th Edition), Gilbert Strang, Cambridge University Press, 2021

Part 4:

material from Linear Algebra and Learning from Data, Gilbert Strang, Wellesley-Cambridge Press, 2019

Usability and Relationship to other Modules

Examination Type: Module Examination

Assessment: Written examination

Duration/Length: 120 min

Weight: 100 %

Scope: All intended learning outcomes of the module

Completion: To pass this module, the assessment has to be passed with at least 45%.

7.2.6 Complex Problem Solving

Module Name		Module Code	Level (type)	CP
Complex Problem Solving		CTNS-NSK-06	Year 3 (New Skills)	5
Module Components				
<i>Number</i>	<i>Name</i>		<i>Type</i>	<i>CP</i>
CTNS-06	Complex Problem Solving		Lecture (online)	5
Module Coordinator	Program Affiliation		Mandatory Status	
Prof. Dr. Marco Verweij	<ul style="list-style-type: none"> Constructor Track Area 		Mandatory elective	
Entry Requirements			Frequency	Forms of Learning and Teaching
<i>Pre-requisites</i>	<i>Co-requisites</i>	<i>Knowledge, Abilities, or Skills</i>	Annually (Fall)	Online Lectures (35h) Private Study (90h)
<i>Logic</i>	<input checked="" type="checkbox"/> none	<ul style="list-style-type: none"> Being able to read primary academic literature Willingness to engage in teamwork 	Duration	Workload
<i>Causation & Correlation</i>			1 semester	125 hours
Recommendations for Preparation				
Please read: Camillus, J. (2008). Strategy as a wicked problem. Harvard Business Review 86: 99-106; Rogers, P. J. (2008). Using programme theory to evaluate complicated and complex aspects of interventions. Evaluation, 14, 29-48.				
Content and Educational Aims				
<p>Complex problems are, by definition, non-linear and/or emergent. Some fifty years ago, scholars such as Herbert Simon began to argue that societies around the world had developed an impressive array of tools with which to solve simple and even complicated problems, but still needed to develop methods with which to address the rapidly increasing number of complex issues. Since then, a variety of such methods has emerged. These include 'serious games' developed in computer science, 'multisector systems analysis' applied in civil and environmental engineering, 'robust decision-making' proposed by the RAND Corporation, 'design thinking' developed in engineering and business studies, 'structured problem solving' used by McKinsey & Co., 'real-time technology assessment' advocated in science and technology studies, and 'deliberative decision-making' emanating from political science.</p> <p>In this course, students first learn to distinguish between simple, complicated and complex problems. They also become familiar with the ways in which a particular issue can sometimes shift from one category into another. In addition, the participants learn to apply several tools for resolving complex problems. Finally, the students are introduced to the various ways in which natural and social scientists can help stakeholders resolve complex problems. Throughout the course examples and applications will be used. When possible, guest lectures will be</p>				

offered by experts on a particular tool for tackling complex issues. For the written, take-home exam, students will have to select a specific complex problem, analyse it and come up with a recommendation – in addition to answering several questions about the material learned.

Intended Learning Outcomes

Upon completion of this module, students will be able to:

1. Identify a complex problem;
2. Develop an acceptable recommendation for resolving complex problems.
3. Understand the roles that natural and social scientists can play in helping stakeholders resolve complex problems;

Indicative Literature

Chia, A. (2019). Distilling the essence of the McKinsey way: The problem-solving cycle. *Management Teaching Review* 4(4): 350-377.

Den Haan, J., van der Voort, M.C., Baart, F., Berends, K.D., van den Berg, M.C., Straatsma, M.W., Geenen, A.J.P., & Hulscher, S.J.M.H. (2020). The virtual river game: Gaming using models to collaboratively explore river management complexity, *Environmental Modelling & Software* 134, 104855,

Folke, C., Carpenter, S., Elmqvist, T., Gunderson, L., Holling, C.S., & Walker, B. (2002). Resilience and sustainable development: Building adaptive capacity in a world of transformations. *AMBIO: A Journal of the Human Environment* 31(5): 437-440.

Ostrom, E. (2010). Beyond markets and states: Polycentric governance of complex economic systems. *American Economic Review* 100(3): 641-72.

Pielke, R. Jr. (2007). *The honest broker: Making sense of science in policy and politics*. Cambridge: Cambridge University Press.

Project Management Institute (2021). *A guide to the project management body of knowledge (PMBOK® guide)*.

Schon, D. A., & Rein, M. (1994). *Frame reflection: Toward the resolution of intractable policy controversies*. New York: Basic Books.

Simon, H. A. (1973). The structure of ill structured problems. *Artificial Intelligence* 4(3-4): 181-201.

Verweij, M. & Thompson, M. (Eds.) (2006). *Clumsy solutions for a complex world*. London: Palgrave Macmillan.

Usability and Relationship to other Modules

Examination Type: Module Examination

Assessment Type: Written examination

Duration: 120 min

Weight: 100%

Scope: All intended learning outcomes of the module.

Completion: To pass this module, the assessment has to be passed with at least 45%.

7.2.7 Argumentation, Data Visualization and Communication (perspective I)

Module Name			Module Code	Level (type)	CP
Argumentation, Data Visualization and Communication (perspective I)			CTNS-NSK-07	Year 3 (New Skills)	5
Module Components					
Number	Name	Type		CP	
CTNS-07	Argumentation, Data Visualization and Communication	Lecture (online)		5	
Module Coordinator	Program Affiliation			Mandatory Status	
Prof. Dr. Jules Coleman, Prof. Dr. Arvid Kappas	<ul style="list-style-type: none"> Constructor Track Area 			Mandatory elective for all UG students (one perspective must be chosen)	
Entry Requirements			Frequency	Forms of Learning and Teaching	
<i>Pre-requisites</i>	<i>Co-requisites</i>	<i>Knowledge, Abilities, or Skills</i>		Annually (Fall)	Online Lectures (35h) Private Study (90h)
<i>Logic</i>	<input checked="" type="checkbox"/> none				
<i>Causation & Correlation</i>			Duration	Workload	
			1 semester	125h	
Recommendations for Preparation					

Content and Educational Aims

One must be careful not to confuse argumentation with being argumentative. The latter is an unattractive personal attribute, whereas the former is a requirement of publicly holding a belief, asserting the truth of a proposition, the plausibility of a hypothesis, or a judgment of the value of a person or an asset. It is an essential component of public discourse. Public discourse is governed by norms and one of those norms is that those who assert the truth of a proposition or the validity of an argument or the responsibility of another for wrongdoing open themselves up to good faith requests to defend their claims. In its most general meaning, argumentation is the requirement that one offer evidence in support of the claims they make, as well as in defense of the judgments and assessments they reach. There are different modalities of argumentation associated with different contexts and disciplines. Legal arguments have a structure of their own as do assessments of medical conditions and moral character. In each case, there are differences in the kind of evidence that is thought relevant and, more importantly, in the standards of assessment for whether a case has been successfully made. Different modalities of argumentation require can call for different modes of reasoning. We not only offer reasons in defense of or in support of beliefs we have, judgments we make and hypotheses we offer, but we reason from evidence we collect to conclusions that are warranted by them.

Reasoning can be informal and sometimes even appear unstructured. When we recognize some reasoning as unstructured yet appropriate what we usually have in mind is that it is not linear. Most reasoning we are familiar with is linear in character. From A we infer B, and from A and B we infer C, which all together support our commitment to D. The same form of reasoning applies whether the evidence for A, B or C is direct or circumstantial. What changes in these cases is perhaps the weight we give to the evidence and thus the confidence we have in drawing inferences from it.

Especially in cases where reasoning can be supported by quantitative data, wherever quantitative data can be obtained either directly or by linear or nonlinear models, the visualization of the corresponding data can become key in both, reasoning and argumentation. A graphical representation can reduce the complexity of argumentation and is considered a must in effective scientific communication. Consequently, the course will also focus on smart and compelling ways for data visualization - in ways that go beyond what is typically taught in statistics or mathematics lectures. These tools are constantly developing, as a reflection of new software and changes in state of the presentation art. Which graph or bar chart to use best for which data, the use of colors to underline messages and arguments, but also the pitfalls when presenting data in a poor or even misleading manner. This will also help in readily identifying intentional mis-representation of data by others, the simplest to recognize being truncating the ordinate of a graph in order to exaggerate trends. This frequently leads to false arguments, which can then be readily countered.

There are other modalities of reasoning that are not linear however. Instead they are coherentist. We argue for the plausibility of a claim sometimes by showing that it fits in with a set of other claims for which we have independent support. The fit is itself the reason that is supposed to provide confidence or grounds for believing the contested claim.

Other times, the nature of reasoning involves establishing not just the fit but the mutual support individual items in the evidentiary set provide for one another. This is the familiar idea of a web of interconnected, mutually supportive beliefs. In some cases, the support is in all instances strong; in others it is uniformly weak, but the set is very large; in other cases, the support provided each bit of evidence for the other is mixed: sometimes strong, sometimes weak, and so on.

There are three fundamental ideas that we want to extract from this segment of the course. These are (1) that argumentation is itself a requirement of being a researcher who claims to have made findings of one sort or another; (2) that there are different forms of appropriate argumentation for different domains and circumstances; and (3) that there are different forms of reasoning on behalf of various claims or from various bits of evidence to conclusions: whether those conclusions are value judgments, political beliefs, or scientific conclusions. Our goal is to familiarize you with all three of these deep ideas and to help you gain facility with each.

Intended Learning Outcomes

Students acquire transferable and key skills in this module.

By the end of this module, the students will be able to:

1. Distinguish among different modalities of argument, e.g. legal arguments, vs. scientific ones.
2. Construct arguments using tools of data visualization.
3. Communicate conclusions and arguments concisely, clearly and convincingly.

Indicative Literature

- Tufte, E.R. (1985). The visual display of quantitative information. The Journal for Healthcare Quality (JHQ), 7(3), 15.
- Cairo, A (2012). The Functional Art: An introduction to information graphics and visualization. New Riders.
- Knaflic, C.N. (2015). Storytelling with data: A data visualization guide for business professionals. John Wiley & Sons.

Usability and Relationship to other Modules

Examination Type: Module Examination

Assessment Type: Written Examination

Duration/Length: 120 (min)

Weight: 100%

Scope: All intended learning outcomes of the module

Completion: To pass this module, the assessment has to be passed with at least 45%.

7.2.8 Argumentation, Data Visualization and Communication (perspective II)

Module Name			Module Code	Level (type)	CP
Argumentation, Data Visualization and Communication (perspective II)			CTNS-NSK-08	Year 3 (New Skills)	5
Module Components					
Number	Name			Type	CP
CTNS-08	Argumentation, Data Visualization and Communication			Lecture (online)	5
Module Coordinator	Program Affiliation			Mandatory Status	
Prof. Dr. Jules Coleman, Prof. Dr. Arvid Kappas	<ul style="list-style-type: none"> Constructor Track Area 			Mandatory elective for all UG students (one perspective must be chosen)	
Entry Requirements			Frequency	Forms of Learning and Teaching	
<i>Pre-requisites</i>	<i>Co-requisites</i>	<i>Knowledge, Abilities, or Skills</i>	Annually (Spring)	<ul style="list-style-type: none"> Online Lecture (35 hours) Tutorial of the lecture (10 hours) Private study for the lecture (80 hours) 	
<input checked="" type="checkbox"/> Logic <input checked="" type="checkbox"/> Causation & Correlation	<input checked="" type="checkbox"/> none	<ul style="list-style-type: none"> ability and openness to engage in interactions media literacy, critical thinking and a proficient handling of data sources own research in academic literature 			
			1 semester	125 hours	
Recommendations for Preparation					
Content and Educational Aims					
<p>Humans are a social species and interaction is crucial throughout the entire life span. While much of human communication involves language, there is a complex multichannel system of nonverbal communication that enriches linguistic content, provides context, and is also involved in structuring dynamic interaction. Interactants achieve goals by encoding information that is interpreted in the light of current context in transactions with others. This complexity implies also that there are frequent misunderstandings as a sender's intention is not fulfilled. Students in this course will learn to understand the structure of communication processes in a variety of formal and informal contexts. They will learn what constitutes challenges to achieving successful communication and to how to communicate effectively, taking the context and specific requirements for a target audience into consideration. These aspects will be discussed also in the scientific context, as well as business, and special cases, such as legal context – particularly with view to argumentation theory.</p> <p>Communication is a truly transdisciplinary concept that involves knowledge from diverse fields such as biology, psychology, neuroscience, linguistics, sociology, philosophy, communication and information science. Students will learn what these different disciplines contribute to an understanding of communication and how theories from these fields can be applied in the real world. In the context of scientific communication, there will also be a focus on visual communication of data in different disciplines. Good practice examples will be contrasted with typical errors to facilitate successful communication also with view to the Bachelor's thesis.</p>					

Intended Learning Outcomes

Upon completion of this module, students will be able to:

1. Analyze communication processes in formal and informal contexts.
2. Identify challenges and failures in communication.
3. Design communications to achieve specified goals to specific target groups.
4. Understand the principles of argumentation theory.
5. Use data visualization in scientific communications.

Indicative Literature

- Joseph A. DeVito: The Interpersonal Communication Book (Global edition, 16th edition), 2022
- Steven L. Franconeri, Lacey M. Padilla, Priti Shah, Jeffrey M. Zacks, and Jessica Hullman: The Science of Visual Data Communication: What Works Psychological Science in the Public Interest, 22(3), 110–161, 2022
- Douglas Walton: Argumentation Theory – A Very Short Introduction. In: Simari, G., Rahwan, I. (eds) Argumentation in Artificial Intelligence. Springer, Boston, MA, 2009

Examination Type: Module Examination

Assessment Type: Digital submission of asynchronous presentation, including reflection

Duration/Length: Asynchronous/Digital submission

Weight: 100%

Scope: All intended learning outcomes of the module

Module achievement: Asynchronous presentation on a topic relating to the major of the student, including a reflection including concept outlining the rationale for how arguments are selected and presented based on a particular target group for a particular purpose. The presentation shall be multimedial and include the presentation of data

The module achievement ensures sufficient knowledge about key concepts of effective communication including a reflection on the presentation itself

Completion: To pass this module, the assessment has to be passed with at least 45%.

7.2.9 Agency, Leadership, and Accountability

Module Name Agency, Leadership, and Accountability		Module Code CTNS-NSK-09	Level (type) Year 3 (New Skills)	CP 5
Module Components				
<i>Number</i>	<i>Name</i>	<i>Type</i>		<i>CP</i>
CTNS-09	Agency, Leadership, and Accountability	Lecture (online)		5
Module Coordinator Prof. Dr. Jules Coleman	Program Affiliation • Constructor Track Area		Mandatory Status Mandatory elective	
Entry Requirements		Frequency	Forms of Learning and Teaching	
<i>Pre-requisites</i> <input checked="" type="checkbox"/> none	<i>Co-requisites</i> <input checked="" type="checkbox"/> none	<i>Knowledge, Abilities, or Skills</i>	Annually (Spring)	Online Lectures (35h) Private Study (90h)
		Duration	Workload	
			125 hours	
Recommendations for Preparation				
Content and Educational Aims				
<p>Each of us is judged by the actions we undertake and held to account for the consequences of them. Sometimes we may be lucky and our bad acts don't have harmful effects on others. Other times we may be unlucky and reasonable decisions can lead to unexpected or unforeseen adverse consequences for others. We are therefore held accountable both for choices and for outcomes. In either case, accountability expresses the judgment that we bear responsibility for what we do and what happens as a result. But our responsibility and our accountability in these cases is closely connected to the idea that we have agency.</p> <p>Agency presumes that we are the source of the choices we make and the actions that result from those choices. For some, this may entail the idea that we have free will. But there is scientific world view that holds that all actions are determined by the causes that explain them, which is the idea that if we knew the causes of your decisions in advance, we would know the decision you would make even before you made it. If that is so, how can your choice be free? And if it is not free, how can you be responsible for it? And if you cannot be responsible, how can we justifiably hold you to account for it?</p> <p>These questions express the centuries old questions about the relationship between free will and a determinist world view: for some, the conflict between a scientific world view and a moral world view.</p> <p>But we do not always act as individuals. In society we organize ourselves into groups: e.g. tightly organized social groups, loosely organized market economies, political societies, companies, and more. These groups have structure. Some individuals are given the responsibility of leading the group and of exercising authority. But one can exercise authority over others in a group merely by giving orders and threatening punishment for non-compliance.</p> <p>Exercising authority is not the same thing as being a leader? For one can lead by example or by encouraging others to exercise personal judgment and authority. What then is the essence of leadership?</p>				

The module has several educational goals. The first is for students to understand the difference between actions that we undertake for which we can reasonably held accountable and things that we do but which we are not responsible for. For example, a twitch is an example of the latter, but so too may be a car accident we cause as a result of a heart attack we had no way of anticipating or controlling. This suggests the importance of control to responsibility. At the heart of personal agency is the idea of control. The second goal is for students to understand what having control means. Some think that the scientific view is that the world is deterministic, and if it is then we cannot have any personal control over what happens, including what we do. Others think that the quantum scientific view entails a degree of indeterminacy and that free will and control are possible, but only in the sense of being unpredictable or random. But then random outcomes are not ones we control either. So, we will devote most attention to trying to understand the relationships between control, causation and predictability.

But we do not only exercise agency in isolation. Sometimes we act as part of groups and organizations. The law often recognizes ways in which groups and organizations can have rights, but is there a way in which we can understand how groups have responsibility for outcomes that they should be accountable for. We need to figure out then whether there is a notion of group agency that does not simply boil down to the sum of individual actions. We will explore the ways in which individual actions lead to collective agency.

Finally we will explore the ways in which occupying a leadership role can make one accountable for the actions of others over which one has authority.

Intended Learning Outcomes

Students acquire transferable and key skills in this module.

By the end of this module, the students will be able to:

1. understand and reflect how the social and moral world views that rely on agency and responsibility are compatible, if they are, with current scientific world views.
2. understand how science is an economic sector, populated by large powerful organizations that set norms, fund research agendas.
3. identify the difference between being a leader of others or of a group – whether a research group or a lab or a company – and being in charge of the group.
4. learn to be a leader of others and groups. Understand that when one graduates one will enter not just a field of work but a heavily structured set of institutions and that one's agency and responsibility for what happens, what work gets done, its quality and value, will be affected accordingly.

Indicative Literature

Hull, David L. "Science as a Process." Science as a Process. University of Chicago Press, 2010;
Feinberg, Joel. "Doing & deserving; essays in the theory of responsibility." (1970).

Usability and Relationship to other Modules

Examination Type: Module Examination

Assessment Type: Written examination

Duration/Length: 120 min

Weight: 100%

Scope: All intended learning outcomes of the module

Completion: To pass this module, the assessment has to be passed with at least 45%.

7.2.10 Community Impact Project

Module Name Community Impact Project		Module Code CTCI-CI-950	Level (type) Year 3 (New Skills)	CP 5
Module Components				
Number	Name	Type	CP	
CTCI-950	Community Impact Project	Project	5	
Module Coordinator	Program Affiliation		Mandatory Status	
CIP Faculty Coordinator	<ul style="list-style-type: none"> Constructor Track Area 		Mandatory elective	
Entry Requirements			Frequency	Forms of Learning and Teaching
Pre-requisites	Co-requisites	Knowledge, Abilities, or Skills	Annually (Fall / Spring)	<ul style="list-style-type: none"> Introductory, accompanying, and final events: 10 hours Self-organized teamwork and/or practical work in the community: 115 hours
<input checked="" type="checkbox"/> at least 15 CP from CORE modules in the major	<input checked="" type="checkbox"/> None	<ul style="list-style-type: none"> Basic knowledge of the main concepts and methodological instruments of the respective disciplines 	Duration	
			1 semester	125 hours
Recommendations for Preparation				
<p>Develop or join a community impact project before the 5th or 6th semester based on the introductory events during the 4th semester by using the database of projects, communicating with fellow students and faculty, and finding potential companies, organizations, or communities to target.</p>				
Content and Educational Aims				
<p>CIPs are self-organized, major-related, and problem-centered applications of students' acquired knowledge and skills. These activities will ideally be connected to their majors so that they will challenge the students' sense of practical relevance and social responsibility within the field of their studies. Projects will tackle real issues in their direct and/or broader social environment. These projects ideally connect the campus community to other communities, companies, or organizations in a mutually beneficial way.</p> <p>Students are encouraged to create their own projects and find partners (e.g., companies, schools, NGOs), but will get help from the CIP faculty coordinator team and faculty mentors to do so. They can join and collaborate in interdisciplinary groups that attack a given issue from different disciplinary perspectives.</p> <p>Student activities are self-organized but can draw on the support and guidance of both faculty and the CIP faculty coordinator team.</p>				
Intended Learning Outcomes				
<p>The Community Impact Project is designed to convey the required personal and social competencies for enabling students to finish their studies at Constructor University as socially conscious and responsible graduates (part of the Constructor University mission) and to convey social and personal abilities to the students, including a practical awareness of the societal context and relevance of their academic discipline.</p> <p>By the end of this project, students will be able to</p> <ul style="list-style-type: none"> understand the real-life issues of communities, organizations, and industries and relate them to concepts in their own discipline; 				

- enhance problem-solving skills and develop critical faculty, create solutions to problems, and communicate these solutions appropriately to their audience;
- apply media and communication skills in diverse and non-peer social contexts;
- develop an awareness of the societal relevance of their own scientific actions and a sense of social responsibility for their social surroundings;
- reflect on their own behavior critically in relation to social expectations and consequences;
- work in a team and deal with diversity, develop cooperation and conflict skills, and strengthen their empathy and tolerance for ambiguity.

Indicative Literature

Usability and Relationship to other Modules

- Students who have accomplished their CIP (6th semester) are encouraged to support their fellow students during the development phase of the next year's projects (4th semester).

Examination Type: Module Examination

Project, not numerically graded (pass/fail)
Scope: All intended learning outcomes of the module

7.3 Language and and Humanities Modules

7.3.1 Languages

The descriptions of the language modules are provided in a separate document, the “Language Module Handbook” that can be accessed from the Constructor University’s Language & Community Center internet sites <https://constructor.university/student-life/language-community-center>.

7.3.2 Humanities

7.3.2.1 Introduction to Philosophical Ethics

Module Name		Module Code	Level (type)	CP
Introduction to Philosophical Ethics		CTHU-HUM-001	Year 1	2.5
Module Components				
Number	Name	Type		CP
CTHU-001	Introduction to Philosophical Ethics	Lecture (online)		2.5
Module Coordinator	Program Affiliation		Mandatory Status	
Dr. Eoin Ryan	<ul style="list-style-type: none"> Constructor Track Area 		Mandatory elective	
Entry Requirements		Frequency	Forms of Learning and Teaching	
<i>Pre-requisites</i>	<i>Co-requisites</i>	Annually (Fall)	Online lectures (17.5 h) Private Study (45h)	
<input checked="" type="checkbox"/> none	<input checked="" type="checkbox"/> none			
		Duration	Workload	
		1 semester	62.5 hours	
Recommendations for Preparation				
Content and Educational Aims				
<p>The nature of morality – how to lead a life that is good for yourself, and how to be good towards others – has been a central debate in philosophy since the time of Socrates, and it is a topic that continues to be vigorously discussed. This course will introduce students to some of the key aspects of philosophical ethics, including leading normative theories of ethics (e.g. consequentialism or utilitarianism, deontology, virtue ethics, natural law ethics, egoism) as well as some important questions from metaethics (are useful and generalizable ethical claims even possible; what do ethical speech and ethical judgements actually do or explain) and moral psychology (how do abstract ethical principles do when realized by human psychologies). The course will describe ideas that are key factors in ethics (free will, happiness, responsibility, good, evil, religion, rights) and indicate various routes to progress in understanding ethics, as well as some of their difficulties.</p>				

Intended Learning Outcomes

Upon completion of this module, students will be able to:

1. Describe normative ethical theories such as consequentialism, deontology and virtue ethics.
2. Discuss some metaethical concerns.
3. Analyze ethical language.
4. Highlight complexities and contradictions in typical ethical commitments.
5. Indicate common parameters for ethical discussions at individual and social levels.
6. Analyze notions such as objectivity, subjectivity, universality, pluralism, value.

Indicative Literature

Simon Blackburn, *Being Good* (2009)

Russ Shafer-Landay, *A Concise Introduction to Ethics* (2019)

Mark van Roojen, *Metaethics: A Contemporary Introduction* (2015)

Usability and Relationship to other Modules***Examination Type: Module Examination***

Assessment Type: Written Examination

Duration/Length: 60 min

Weight: 100%

Scope: All intended learning outcomes of the module.

Completion: To pass this module, the assessment has to be passed with at least 45%.

7.3.2.2 Introduction to the Philosophy of Science

Module Name Introduction to the Philosophy of Science		Module Code CTHU-HUM-002	Level (type) Year 1	CP 2.5
Module Components				
<i>Number</i>	<i>Name</i>	<i>Type</i>	<i>CP</i>	
CTHU-002	Introduction to the Philosophy of Science	Lecture (online)	2.5	
Module Coordinator Dr. Eoin Ryan	Program Affiliation <ul style="list-style-type: none"> Constructor Track Area 		Mandatory Status Mandatory elective	
Entry Requirements		Frequency	Forms of Learning and Teaching	
<i>Pre-requisites</i> <input checked="" type="checkbox"/> none	<i>Co-requisites</i> <input checked="" type="checkbox"/> none	<i>Knowledge, Abilities, or Skills</i>	Annually (Spring)	Online lectures (17.5h) Private Study (45h)
		Duration	Workload	
		1 semester	62.5 hours	
Recommendations for Preparation				
Content and Educational Aims				
<p>This humanities module will introduce students to some of the central ideas in philosophy of science. Topics will include distinguishing science from pseudo-science, types of inference and the problem of induction, the pros and cons of realism and anti-realism, the role of explanation, the nature of scientific change, the difference between natural and social sciences, scientism and the values of science, as well as some examples from philosophy of the special sciences (e.g., physics, biology).</p> <p>The course aims to give students an understanding of how science produces knowledge, and some of the various contexts and issues which mean this process is never entirely transparent, neutral, or unproblematic. Students will gain a critical understanding of science as a human practice and technology; this will enable them both to better understand the importance and success of science, but also how to properly critique science when appropriate.</p>				
Intended Learning Outcomes				
<p>Upon completion of this module, students will be able to:</p> <ol style="list-style-type: none"> Understand key ideas from the philosophy of science. Discuss different types of inference and rational processes. Describe differences between how the natural sciences, social sciences and humanities discover knowledge. Identify ways in which science can be more and less value-laden. Illustrate some important conceptual leaps in the history of science. 				
Indicative Literature				
<p>Peter Godfrey-Smith, <i>Theory and Reality</i> (2021)</p> <p>James Ladyman, <i>Understanding Philosophy of Science</i> (2002)</p> <p>Paul Song, <i>Philosophy of Science: Perspectives from Scientists</i> (2022)</p>				
Usability and Relationship to other Modules				

Examination Type: Module Examination

Assessment Type: Written Examination

Duration/Length: 60 min

Weight: 100%

Scope: All intended learning outcomes of the module.

Completion: To pass this module, the assessment has to be passed with at least 45%.

7.3.2.3 Introduction to Visual Culture

Module Name Introduction to Visual Culture		Module Code CTHU-HUM-003	Level (type) Year 1	CP 2.5
Module Components				
Number	Name	Type		CP
CTHU-003	Introduction to Visual Culture	Lecture (online)		2.5
Module Coordinator Irina Chiaburu	Program Affiliation • Constructor Track Area		Mandatory Status Mandatory elective	
Entry Requirements		Frequency	Forms of Learning and Teaching	
Pre-requisites <input checked="" type="checkbox"/> none	Co-requisites <input checked="" type="checkbox"/> none	Knowledge, Abilities, or Skills •	Annually (Spring/Fall)	Online Lecture
		Duration 1 semester	Workload 62.5 h	
Recommendations for Preparation				
Content and Educational Aims				
<p>Of the five senses, the sense of sight has for a long time occupied the central position in human cultures. As John Berger has suggested this could be because we can see and recognize the world around us before we learn how to speak. Images have been with us since the earliest days of the human history. In fact, the earliest records of human history are images found on cave walls across the world. We use images to capture abstract ideas, to catalogue and organize the world, to represent the world, to capture specific moments, to trace time and change, to tell stories, to express feelings, to better understand, to provide evidence and more. At the same time, images exert their power on us, seducing us into believing in their 'innocence', that is into forgetting that as representations they are also interpretations, i.e., a particular version of the world.</p> <p>The purpose of this course is to explore multiple ways in which images and the visual in general mediate and structure human experiences and practices from more specialized discourses, e.g., scientific discourses, to more informal and personal day-to-day practices, such as self-fashioning in cyberspace. We will look at how social and historical contexts affect <i>how</i> we see, as well as <i>what is visible</i> and what is not. We will explore the centrality of the visual to the intellectual activity, from early genres of scientific drawing to visualizations of big data. We will examine whether one can speak of visual culture of protest, look at the relationship between looking and subjectivity and, most importantly, ponder the relationship between the visual and the real.</p>				
Intended Learning Outcomes				
<p>Upon completion of this module, students will be able to:</p> <ul style="list-style-type: none"> • Understand a range of key concepts pertaining to visual culture, art theory and cultural analysis • Understand the role of visuality in development and maintenance of political, social, and intellectual discourses • Think critically about images and their contexts • Reflect critically on the connection between seeing and knowing 				
Indicative Literature				
<p>Berger, J., Blomberg, S., Fox, C., Dibb, M., & Hollis, R. (1973). <i>Ways of seeing</i>. Foucault, M. (2002). <i>The order of things: an archaeology of the human sciences</i> (Ser. Routledge classics). Routledge.</p>				

Hunt, L. (2004). *Politics, culture, and class in the French revolution: twentieth anniversary edition, with a new preface* (Ser. Studies on the history of society and culture, 1). University of California Press.
Miller, V. (2020). *Understanding digital culture* (Second). SAGE.
Thomas, N. (1994). *Colonialism's culture: anthropology, travel and government*. Polity Press.

Usability and Relationship to other Modules

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Examination Type: Module Examination

Assessment: Written examination

Duration/Length: 60 min.

Weight: 100%

Scope: all intended learning outcomes

Completion: To pass this module, the assessment has to be passed with at least 45%.

8 Appendix

8.1 Intended Learning Outcomes Assessment-Matrix

Management, Decisions and Data Analysis (MDDA)		Introduction to International Business	Introduction to Finance and Accounting	Essentials of Cognitive Psychology	Essentials of Social Psychology	Introduction to Data Science	Data Structures and Processing	Digital Transformation and Information Economy	Design Thinking, E-Business & E-Services	Entrepreneurship and Innovation	Social Cognition	Org. Psychology & Communication	Judgment & Decision-Making	Data Analytics and Modeling	Applied Machine Learning	Data Analytics	Contemporary Topics in Marketing	Advanced Econometrics	Internship / Startup and Career Skills	Bachelor Thesis	CT Methods	CT German Language and Humanities Modules	CT New Skills			
Semester		1	2	1	2	1	2	3	3	4	3	3/4	4	3	4	5	5	5	4-5	6	1-4	1-2	3-6			
Mandatory/ optional		m	m	m	m	m	m	m	m	m	m	m	m	m	m	me	me	me	m	m	m	m	m			
ECTS Credits		7,5	7,5	7,5	7,5	7,5	7,5	5	2,5	7,5	5	5	5	7,5	7,5	5	5	5	15,0	15,0	20,0	5,0	20,0			
Program Learning Outcomes		Competencies*																								
	A	E	P	S																						
understand and analyze the important issues that influence the choice of business strategy in a data-driven economy	x	x	x					x	x	x		x				x	x		x	x						
develop practical knowledge and management skills for digital transformation	x	x						x	x	x						x	x		x	x						
describe the major models and theories of behavioral decision making	x			x	x					x	x	x	x					x		x	x					
discuss applications of decision-making research in business	x		x	x	x	x		x	x	x	x	x	x			x	x	x	x	x						
apply and evaluate social cognitive and social influence theories to explain or predict real-world phenomena	x	x	x	x				(x)	(x)	x	x	x	x					x		x	x					
apply fundamental data science methods to structured data and use state-of-the-art tools to prepare and process unstructured data	x	x				x	x							x	x	x		x	(x)	x	x					
identify and evaluate important problem types and solution approaches in data analytics	x	x				x	x	x	x	x				x	x	x	x		x	x						
transform theoretical knowledge from management, decision making and data analytics into creative approaches while solving real-world problems;	x	x	x	x	(x)	(x)	x	x	x	x	(x)	(x)	x	x	x	x	x	x	x	x	x					
use academic or scientific methods as appropriate in the field of MDDA such as defining research questions, justifying methods, collecting, assessing and interpreting relevant information, and drawing scientifically-founded conclusions that consider social, scientific and ethical insights	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x			
develop and advance solutions to problems and arguments in their subject area and defend these in discussions with specialists and non-specialists	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x					
engage ethically with academic, professional and wider communities and to actively contribute to a sustainable future, reflecting and respecting different views	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x			
take responsibility for their own learning, personal and professional development and role in society, evaluating critical feedback and self-analysis	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x			
apply their knowledge and understanding to a professional context	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x					
take on responsibility in a diverse team	x	x	x	x	x	x			x	x	x	x	x			x	x		x							
adhere to and defend ethical, scientific and professional standards	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x			
Assessment Type																										
Oral examination																										
Written examination		x	x	x	x	x	x					x	x	x	x							x	x			
Project										x						x							x			
Term paper											x						x	x								
Lab report											x															
Poster presentation																										
Presentation								x	x												x	x	x			
Variable																							x			
Module achievements or bonus points																										

*Competencies: A-scientific/academic proficiency; E-competence for qualified employment; P-development of personality; S-competence for engagement in society

Figure 3: Intended Learning Outcomes Assessment-Matrix