COURSE HANDBOOK

Data Science (BSc) /

Data Science with Finance (BSc (Hons))

The London Institute of Banking & Finance

INTERNATIONALE HOCHSCHULE

Table of Contents

1st semester

Course Descriptors
June 2022

Introduction to Data Science

COURSE DESCRIPTOR

Module name	Introduction to Data Science
Course name	Introduction to Data Science
Level	4
Course Code	DLBDSIDS
Credit Value	10 UK Credits
Study-load	Contact hours: 20 Student managed learning hours: 130
Pre-requisites	None
Co-requisites	None
Dis-requisites	None
Course leader	Prof. Dr. Thomas Zöller
Module content outline	Data science emerged as a multi-disciplinary field aimed at creating value from data. This course starts with an overview of data science and related fields and then defines data types and sources. Special focus is put on the assessment of data quality and electronic data processing. Use of data-driven methods has become vital for businesses, and this course outlines how data-driven approaches can be integrated within a business context and how operational decisions can be made using data-driven methods. Finally, this course highlights the importance of statistics and machine learning in the field of data science and gives an overview of relevant methods and approaches.
Course aims	This course starts with an overview of data science and related fields and then defines data types and sources. Special focus is put on the assessment of data quality and electronic data processing. Finally, this course highlights the importance of statistics and machine learning in the field of data science and gives an overview of relevant methods and approaches.
Learning Outcomes	Having completed this module, students will be able to • define data science and its relation to other fields. • comprehend data science activities. • recognize the origins of data and the challenges of working with data. understand how data science methods are integrated into business settings. grasp fundamental statistical concepts. • appreciate the importance of machine learning in data science.
Careers/Graduate destinations	Entry to mid level.
Teaching and learning methods	Contact hours includes the following: (please click on the checkboxes as appropriate) ☒ Lectures ☐ Group Work:

	☐ Seminars ☒ Tutorial ☐ Laboratory ☐ Workshops ☐ Practical ☒ VLE Activities
Indicative content	1. Introduction to Data Science 1.1 Definition of the term „data science“ 1.2 Data science and related fields 1.3 Data science activities 2. Data 2.1 Data types and data sources 2.2 The 5Vs of data 2.3 Data curation and data quality 2.4 Data engineering 3. Data Science in Business 3.1 Identification of use cases 3.2 Performance evaluation 3.3 Data-driven operational decisions 3.4 Cognitive biases 4. Statistics 4.1 Importance of statistics for data science 4.2 Important statistical concepts 5. Machine Learning 5.1 Role of machine learning in data science 5.2 Overview of machine learning approaches
Assessment method	Formative assessment: Summative assessment: Oral Assignment (100%) At IU formative assessment is also informal and done within class. This practice of the summative assessment does not impact on the final summative assessment grade. This practice opportunity familiarises students with the assessment type and provides formative feedback that students can use for their final assessment. Formative assessment is also used as part of the process of supporting students reflect on their own learning. This course offers several practice exams.
Reading list	Required reading: See IU coursebook on Introduction to Data Science. Additional reading (optional): • Akerkar, R., & Sajja, P. S. (2016). Intelligent techniques for data science. New York, NY: Springer International Publishing. • Hodeghatta, U. R., & Nayak, U. (2017). Business analytics using R—A practical approach. New York, NY: Apress Publishing. • Runkler, T. A. (2012). Data analytics: Models and algorithms for intelligent data analysis. New York, NY: Springer. • Skiena, S. S. (2017). The data science design manual. New York, NY: Springer International Publishing.
Other Learning Resources	See MyCampus platform.

Course Descriptors
June 2022

Introduction to Academic Work

COURSE DESCRIPTOR

Module name	Introduction to Academic Work
Course name	Introduction to Academic Work
Level	4
Course Code	DLBCSIAW
Credit Value	10 UK Credits
Study-load	Contact hours: 20 Student managed learning hours: 130
Pre-requisites	None
Co-requisites	None
Dis-requisites	None
Course leader	Prof. Dr. Maya Stagge
Module content outline	The application of good scientific practice is one of the basic academic qualifications that should be acquired while studying. This course deals with the distinction between everyday knowledge and science. This requires a deeper understanding of the theory of science, as well as the knowledge of basic research methods and instruments for writing scientific texts. The students therefore gain initial insight into academic research and are introduced to the basic knowledge that will help them in the future to produce scientific papers. In addition, the students receive an overview of the different IU examination forms and insight into their requirements and implementation.
Course aims	The students therefore gain initial insight into academic research and are introduced to the basic knowledge that will help them in the future to produce scientific papers.
Learning Outcomes	Having completed this module, students will be able to • understand and apply formal criteria of a scientific work. • distinguish basic research methods and identify criteria of good scientific practice. describe central scientific theoretical basics and research paradigms and their effects on scientific research results. • use literature databases, literature administration programs, and other library structures properly; avoid plagiarism; and apply citation styles correctly. • apply the evidence criteria to scientific texts. • define a research topic and derive a structure for scientific texts. • compile a list of literature, illustrations, tables, and abbreviations for scientific texts. understand and distinguish between the different forms of scientific work at IU.

Careers/Graduate destinations	Entry to mid level positions with administrative tasks.
Teaching and learning methods	Contact hours includes the following: (please click on the checkboxes as appropriate) ☒ Lectures ☐ Group Work: ☐ Seminars ☒ Tutorial ☐ Laboratory ☐ Workshops ☐ Practical ☒ VLE Activities
Indicative content	1. Theory of Science 1.1 Introduction to Science and Research 1.2 Research Paradigms 1.3 Fundamental Research Decisions 1.4 Effects of Scientific Paradigms on Research Design 2. Application of Good Scientific Practice 2.1 Research Ethics 2.2 Evidence Teaching 2.3 Data Protection and Affidavit 2.4 Orthography and Shape 2.5 Identification and Delimitation of Topics 2.6 Research Questions and Structure 3. Research Methods 3.1 Empirical Research 3.2 Literature and Reviews 3.3 Quantitative Data Collection 3.4 Qualitative Data Collection 3.5 Mix of Methods 3.6 Critique of Methods and Self-Reflection 4. Librarianship: Structure, Use, and Literature Management 4.1 Plagiarism Prevention 4.2 Database Research 4.3 Literature Administration 4.4 Citation and Author Guidelines 4.5 Bibliography 5. Scientific Work at the IU– Research Essay 6. Scientific Work at the IU - Project Report 7. Scientific Work at the IU - Case Study 8. Scientific Work at the IU - Bachelor Thesis 9. Scientific Work at the IU – Oral Assignment 10. Scientific Work at the IU – Oral Project Report 11. Scientific Work at the IU – Colloquium 12. Scientific Work at the IU – Portfolio 13. Scientific Work at the IU - Exam
Assessment method	Formative assessment: Summative assessment: Workbook (100%) At IU formative assessment is also informal and done within class. This practice of the summative assessment does not impact on the final summative assessment grade. This practice opportunity familiarises students with the assessment type and provides formative feedback that

	students can use for their final assessment. Formative assessment is also used as part of the process of supporting students reflect on their own learning. This course offers several practice exams.
Reading list	Required reading: See IU coursebook on Introduction to Academic Work. Additional reading (optional): • Bell, J., & Waters, S. (2018). Doing your research project: A guide for first-time researchers (7th ed.). Open University Press McGraw-Hill Education. • Deb, D., Dey, R., & Balas, V. E. (2019). Engineering research methodology: A practical insight for researchers. Springer. • Saunders, M., Lewis, P., & Thornhill, A. (2019). Research Methods for Business Students (8th ed.). Pearson. • Veal, A. J. (2018). Research Methods for Leisure and Tourism (5th ed.). Pearson.
Other Learning Resources	See MyCampus platform.

Course Descriptors
June 2022

Introduction to Programming with Python

COURSE DESCRIPTOR

Module name	Introduction to Programming with Python
Course name	Introduction to Programming with Python
Level	4
Course Code	DLBDSIPWP
Credit Value	10 UK Credits
Study-load	Contact hours: 30 Self-test: 30h Student managed learning hours: 90
Pre-requisites	None
Co-requisites	None
Dis-requisites	None
Course leader	Dr. Reza Shahbazfar
Module content outline	This course provides students with a foundational understanding of the Python programming language. Following an introductory exposition to the importance of Python for data science-related programming tasks, students will be acquainted with fundamental programming concepts like variables, data types, and statements. Building on this basis, the important notion of a function is explained and errors, exception handling, and logging are explicated. The course concludes with an overview of the most widely-used library packages for data science.
Course aims	This course provides students with a foundational understanding of the Python programming language.
Learning Outcomes	Having completed this module, students will be able to • use fundamental Python syntax. • recollect common elementary data types. • recognize foundational programming concepts and their realization in Python. understand error handling and logging. • create working programs. • list the most important libraries and packages for data science.
Careers/Graduate destinations	Entry to mid level.
Teaching and learning methods	Contact hours includes the following: (please click on the checkboxes as appropriate) ☒ Lectures ☐ Group Work: ☐ Seminars ☒ Tutorial ☐ Laboratory ☐ Workshops ☐ Practical ☒ VLE Activities

Indicative content	1. Introduction 1.1 Why Python? 1.2 Obtaining and installing Python 1.3 The Python interpreter , IPython, and Jupyter 2. Variables and Data Types 2.1 Variables and value assignment 2.2 Numbers 2.3 Strings 2.4 Collections 2.5 Files 3. Statements 3.1 Assignment, expressions, and print 3.2 Conditional statements 3.3 Loops 3.4 Iterators and comprehensions 4. Functions 4.1 Function declaration 4.2 Scope 4.3 Arguments 5. Errors and Exceptions 5.1 Errors 5.2 Exception handling 5.3 Logs 6. Courses and Packages 6.1 Usage 6.2 Namespaces 6.3 Documentation 6.4 Popular data science packages
Assessment method	Formative assessment: Summative assessment: Exam (100% - 90min) At IU formative assessment is informal and done within class. This practice of the summative assessment does not impact on the final summative assessment grade. This practice opportunity familiarises students with the assessment type and provides formative feedback that students can use for their final assessment. Formative assessment is also used as part of the process of supporting students reflect on their own learning. This course offers several practice exams.
Reading list	Required reading: See IU coursebook on Introduction to Programming with Python. Additional reading (optional): • Barry, P. (2016): Head first Python: A brain-friendly guide. 2nd ed., O'Reilly, Sebastopol, CA. • Kapil, S. (2019). Clean Python: Elegant coding in Python. Berkeley, CA: Apress.

	• Lubanovic, B. (2019): Introducing Python. 2nd ed., O'Reilly, Sebastopol, CA. • Lutz, M. (2013): Learning Python. 5th ed., O'Reilly, Sebastopol, CA. • Matthes, E. (2019): Python crash course: A hands-on, project-based introduction to programming. 2nd ed., No Starch Press, San Francisco, CA. • Müller, A. C., & Guido, S. (2016). Introduction to machine learning with Python: A guide for data scientists. Sebastopol, CA: O'Reilly Media, Inc. • Ramalho, L. (2015): Fluent Python: Clear, concise, and effective programming. O'Reilly, Sebastopol, CA.
Other Learning Resources	See MyCampus platform.

Course Descriptors
June 2022

Mathematics: Analysis

COURSE DESCRIPTOR

Module name	Mathematics: Analysis
Course name	Mathematics: Analysis
Level	4
Course Code	DLBDSMFC
Credit Value	10 UK Credits
Study-load	Contact hours: 30h Self study: 30h Student managed learning hours: 90h
Pre-requisites	None
Co-requisites	None
Dis-requisites	None
Course leader	Prof. Dr. Robert Graf
Module content outline	Analysis is one of the essential basic subjects of mathematics. Originally developed to be able to formulate and solve problems of classical mechanics mathematically, in its present rigorous form it has become indispensable in numerous applications in the natural sciences and technology. This course aims to introduce the basic hand tool of differential and integral calculus and to explain their mutual interrelations. In addition, the differential calculus is generalized to multidimensional spaces.
Aims	This course aims to introduce the basic hand tool of differential and integral calculus and to explain their mutual interrelations.
Learning Outcomes	Having completed this module, students will be able to • summarize the basic concepts of analysis. • illustrate the terms "consequences" and "series". • explain the concept of function and to understand the concept of the inverse function. explain basic statements of the differential and integral calculus. • explain the relationship between differentiation and integration. • master the derivation of higher-dimensional functions.
Careers/Graduate destinations	Entry to mid level positions with administrative tasks.
Teaching and learning methods	Contact hours includes the following: (please click on the checkboxes as appropriate) ☒ Lectures ☐ Group Work: ☐ Seminars ☒ Tutorial ☐ Laboratory ☐ Workshops ☐ Practical ☒ VLE Activities
Indicative content	1. Sequences and series

	1.1 Sequences and series 1.2 Convergence of infinite series 1.3 power series 2. Functions and reverse functions 2.1 Continuous functions 2.2 Exponential and logarithm function 2.3 Trigonometric functions and their inverse functions 3. Differential calculus 3.1 Derivatives and higher derivatives 3.2 curve discussion 3.3 Rules (chain rule, product rule, quotient rule ...) 3.4 Taylor Rows 4. Integral calculus 4.1 The Riemann Integral 4.2 Specific and indefinite integrals 4.3 The fundamental theorem of differential and integral calculus 4.4 Volumes and shells of rotary bodies 4.5 Paths and lengths 5. Differential calculus in the Rn 5.1 Partial Derivation 5.2 Total Derivation 5.3 Gradients of vector-valued functions and matrices
Assessment method	Formative assessment: Summative assessment: Exam (100% - 90min) At IU formative assessment is informal and done within class. This practice of the summative assessment does not impact on the final summative assessment grade. This practice opportunity familiarises students with the assessment type and provides formative feedback that students can use for their final assessment. Formative assessment is also used as part of the process of supporting students reflect on their own learning.
Reading list	Required reading: See IU coursebook on Mathematics Analysis. Additional reading (optional): • Deisenroth, M.P., Faisal, A.A., & Ong, C.S. (2020). Mathematics for Machine Learning. Cambridge University Press. • Magnus, R. (2020). Fundamental Mathematical Analysis. Springer International Publishing.
Other Learning Resources	See MyCampus platform.

Course Descriptors
June 2022

Collaborative Work

COURSE DESCRIPTOR

Module name	Collaborative Work
Course name	Collaborative Work
Level	4
Course Code	DLBCSCW
Credit Value	10 UK Credits
Study-load	Contact hours: 20h Self test: 20h Student managed learning hours: 110h
Pre-requisites	None
Co-requisites	None
Dis-requisites	None
Course leader	Prof. Dr. Karin Halbritter
Module content outline	The course supports the students in building up and expanding important interdisciplinary competences for our networked world, and in doing so, students can take advantage of the opportunities for constructive cooperation with others. It presents essential forms and design possibilities of collaborative learning and working, imparts basic knowledge and tools for self-managed, flexible, and creative thinking, learning and acting and familiarizes students with the topics of empathy and emotional intelligence. Students are also encouraged to use the course contents. In this way, they promote their autonomous competence to act and their competence in the interactive application of tools and in interacting in heterogeneous groups.
Course aims	The course supports the students in building up and expanding important interdisciplinary competences for our networked world, and in doing so, students can take advantage of the opportunities for constructive cooperation with others. It presents essential forms and design possibilities of collaborative learning and working, imparts basic knowledge and tools for self- managed, flexible, and creative thinking, learning and acting and familiarizes students with the topics of empathy and emotional intelligence. Students are also encouraged to use the course contents. In this way, they promote their autonomous competence to act and their competence in the interactive application of tools and in interacting in heterogeneous groups.
Learning Outcomes	Having completed this module, students will be able to ▪ design their own learning processes both self-directed and collaborative with analog and digital media. ▪ initiate face-to-face and virtual cooperation and select suitable methods forshaping collaboration even in an

	intercultural context and across disciplinaryboundaries. ▪ assess different forms of communication in relation to the goals and requirements of different situations and to reflect on their own communication and argumentation behavior in order to be able to shape conducive collaboration also in an interdisciplinary context. ▪ recognize social diversity including cultural and professional differences as a value, and to name and apply tools to deal with them constructively. ▪ explain conflict potentials and the role of emotions in conflicts and to describe the use of systemic methods in the target- and solution-oriented handling ofconflicts. ▪ analyze one's own resources, present methods of self-leadership and self-motivation, and derive appropriate strategies.
Careers/Graduate destinations	Entry to mid level.
Teaching and learning methods	Contact hours includes the following: (please click on the checkboxes as appropriate) ☒ Lectures ☐ Group Work: ☐ Seminars ☒ Tutorial ☐ Laboratory ☐ Workshops ☐ Practical ☒ VLE Activities
Indicative content	1. Learning for a Networked World in a Networked World 1.1 Requirements and Opportunities of the VUCA World 1.2 Learning, Information, and Dealing with Knowledge and Ignorance 1.3 C-Model: Collective – Collaborative – Continuous – Connected 1.4 Checking Your Own Learning Behaviour 2. Networking and Cooperation 2.1 Finding and Winning Suitable Cooperation Partners 2.2 Sustainable Relationships: Digital Interaction and Building Trust 2.3 Collaboration: Organizing Locally and Virtually and Using Media 2.4 Social Learning: Agile, Collaborative, and Mobile Planning of Learning Processes 3. Performance in (Virtual) Teams 3.1 Goals, Roles, Organization and Performance Measurement 3.2 Team Building and Team Flow 3.3 Scrum as a Framework for Agile Project Management 3.4 Design Thinking, Kanban, Planning Poker, Working-in-Progress-Limits & Co 4. Communicate and Convince 4.1 Communication as Social Interaction 4.2 Language, Images, Metaphors, and Stories 4.3 It's the Attitude that Counts: Open, Empathetic, and Appreciative Communication 4.4 Listen Actively - Argue - Convince – Motivate

	4.5 Analyze Your Own Conversational and Argumentational Skills 5. Recognize Conflict Potentials - Handle Conflicts - Negotiate Effectively 5.1 Respecting Diversity - Seizing Opportunities 5.2 Developing Empathy for Yourself and Others 5.3 Systemic Work Solutions and Reframing 5.4 Negotiate Constructively: Finding Clear Words - Interests Instead of Positions 6. Realize Your Own Projects 6.1 Set Goals Effectively - Focus – Reflect 6.2 The Agile Use of One's Own Time 6.3 (Self-)Coaching and Inner Team 6.4 Strategies and Methods for Self-Management and Self-Motivation 7. Mobilize Your Resources 7.1 Recognizing Resources - Regulating Emotions 7.2 Reflection and Innovation - Lateral Thinking and Creativity 7.3 Transfer Strength and Willpower: Analyzing and Controlling Condition Factors
Assessment method	Formative assessment: Oral Assignment Summative assessment: At IU formative assessment is also informal and done within class. This practice of the summative assessment does not impact on the final summative assessment grade. This practice opportunity familiarises students with the assessment type and provides formative feedback that students can use for their final assessment. Formative assessment is also used as part of the process of supporting students reflect on their own learning. This course offers several practice exams.
Reading list	Required reading: See IU coursebook on Collaborative Work. Additional reading (optional): • Baber, A., Waymon, L., Alphonso, A., & Wylde, J. (2015): Strategic connections. The new face of networking in a collaborative world. New York: AMACOM. • Boulton, J. G., Allen, P. M., & Bowman, C. (2015): Embracing complexity. Strategic perspectives for an age of turbulence. 1. ed. Oxford: Oxford Univ. Press. • Chang, B., & Kang, H. (2016): Challenges facing group work online. In: Distance Education 37 (1), S. 73–88. DOI: 10.1080/01587919.2016.1154781. • Duhigg, C. (2013): The power of habit. Why we do what we do and how to change. London: Random House Books.

	• Fisher, R., & Ury, W. (2012): Getting to yes. Negotiating an agreement without giving in. Updated and rev., 3. ed. London: Random House Business Books. • Kaats, E., & Opheij, W. (2014): Creating conditions for promising collaboration. Alliances, networks, chains, strategic partnerships. Berlin, Heidelberg, s.l.: Springer Berlin Heidelberg (SpringerBriefs in Business). • Martin, S. J., Goldstein, N. J., & Cialdini, R. B. (2015). The small BIG: Small changes that spark BIG influence. London, England: Profile Books. • Oettingen, G. (2014). Rethinking positive thinking: Inside the new science of motivation. New York, NY: Current.
Other Learning Resources	See MyCampus platform.

Course Descriptors
June 2022

Statistics: Probability and Descriptive Statistics

COURSE DESCRIPTOR

Module name	Statistics: Probability and Descriptive Statistics
Course name	Statistics: Probability and Descriptive Statistics
Level	4
Course Code	DLBDSSPDS
Credit Value	10 UK Credits
Study-load	Contact hours: 30h Self study: 30h Student managed learning hours: 90h
Pre-requisites	None
Co-requisites	None
Dis-requisites	None
Course leader	Dr. Stefan Stöckl
Module content outline	Statistical description and analysis are the foundations for data-driven analysis and prediction methods. This course introduces the fundamentals, beginning with a formal definition of probabilities and introduction to the concepts underlying Bayesian statistics. Random variables and probability density distributions are then discussed, as well as the concept of joint and marginal distributions. The importance of various discrete and continuous distributions and their applications is stressed. Characterizing distributions is an important aspect of describing the behavior of probability distributions. Students are familiarized with expectation values, variance, and covariance. The concepts of algebraic and central moments and moment-generating functions complement the characterization of probability distributions. Finally, this course focuses on important inequalities and limit theorems such as the law of large numbers or the central limit theorem.
Course aims	Students are familiarized with expectation values, variance, and covariance.
Learning Outcomes	Having completed this module, students will be able to • define probability, random variable, and probability distribution. • understand the concept of Bayesian statistics. • grasp the definition of joint and marginal distributions. • calculate expectation values and higher moments. • comprehend important inequality equations and limit theorems.

Careers/Graduate destinations	Entry to mid level positions with administrative tasks.
Teaching and learning methods	Contact hours includes the following: (please click on the checkboxes as appropriate) ☒ Lectures ☐ Group Work: ☐ Seminars ☒ Tutorial ☐ Laboratory ☐ Workshops ☐ Practical ☒ VLE Activities
Indicative content	1. Probability 1.1 Definitions 1.2 Independent events 1.3 Conditional probability 1.4 Bayesian statistics 2. Random Variables 2.1 Random Variables 2.2 Distribution functions and probability mass functions 2.3 Important discrete probability distributions 2.4 Important continuous probability distributions 3. Joint Distributions 3.1 Joint distributions 3.2 Marginal distributions 3.3 Independent random variables 3.4 Conditional distributions 4. Expectation and Variance 4.1 Expectation of a random variable, conditional expectations 4.2 Variance and covariance 4.3 Expectations and variances of important probability distributions 4.4 Algebraic and central moments 4.5 Moment-generating functions 5. Inequalities and Limit Theorems 5.1 Probability inequalities 5.2 Inequalities for expectations 5.3 The law of large numbers 5.4 Central limit theorem
Assessment method	Formative assessment: Summative assessment: Exam (100% - 90min) At IU formative assessment is informal and done within class. This practice of the summative assessment does not impact on the final summative assessment grade. This practice opportunity familiarises students with the assessment type and provides formative feedback that students can use for their final assessment. Formative assessment is also used as part of the process of supporting students reflect on their own learning. This course offers several practice exams.

Reading list	Required reading: See IU coursebook on Statistics: Probability and Descriptive Statistics. Additional reading (optional): • Downey, A.B. (2011). Think stats (2nd ed.). Sebastopol, CA: O'Reilly • Kim, A. (2019). Exponential Distribution—Intuition, Derivation, and Applications. Available online. • Wasserman, L. (2004). All of Statistics: A concise course in statistical inference. New York, NY: Springer
Other Learning Resources	See MyCampus platform.

2nd semester

Course Descriptors
June 2022

Object Oriented and Functional Programming with Python

COURSE DESCRIPTOR

Module name	Object Oriented and Functional Programming with Python
Course name	Object Oriented and Functional Programming with Python
Level	4
Course Code	DLBDSOOFPP
Credit Value	10 UK Credits
Study-load	Contact hours: 30h Student managed learning hours: 120h
Pre-requisites	DLBDSIPWP
Co-requisites	None
Dis-requisites	None
Course leader	Prof. Dr. Max Pumperla
Module content outline	This course builds upon basic knowledge of Python programming (Introduction to Programming with Python, DLBDSIPWP) and is concerned with the exposition of advanced Python programming concepts. To this end, important notions of object-oriented programming like classes and objects and pertaining design principles are outlined. Starting from an in-depth discussion of advanced features of Python functions, functional programming concepts and their implementation in Python are conveyed.
Course aims	This course builds upon basic knowledge of Python programming (Introduction to Programming with Python, DLBDSIPWP) and is concerned with the exposition of advanced Python programming concepts.
Learning Outcomes	Having completed this module, students will be able to • explain basic notions in object-oriented programming such as functions and classes. understand object-oriented programming concepts and their relation to software design and engineering. • describe advanced function concepts in Python. • recognize important ideas from functional programming. • recall important libraries for functional programming in Python.
Careers/Graduate destinations	Entry to mid level positions with administrative tasks.
Teaching and learning methods	Contact hours includes the following: (please click on the checkboxes as appropriate) ☒ Lectures ☐ Group Work: ☐ Seminars ☒ Tutorial ☐ Laboratory ☐ Workshops ☐ Practical ☒ VLE Activities

Indicative content	This course provides students with a thorough introduction to important notions and concepts from the domain of object-oriented programming such as classes, objects, abstraction, encapsulation, inheritance, polymorphism, composition, and delegation. Additionally, the functional programming paradigm and pertaining ideas like functions as first class objects, decorators, pure functions, immutability and higher order functions are conveyed. Pursuant to the portfolio course type, the aforementioned concepts and ideas are explored by hands-on programming projects.
Assessment method	Formative assessment: Summative assessment: Portfolio (100%) At IU formative assessment is also informal and done within class. This practice of the summative assessment does not impact on the final summative assessment grade. This practice opportunity familiarises students with the assessment type and provides formative feedback that students can use for their final assessment. Formative assessment is also used as part of the process of supporting students reflect on their own learning.
Reading list	Required reading: Additional reading (optional): • Lott, S. F. (2018): Functional Python programming: Discover the power of functional programming, generator functions, lazy evaluation, the built-in itertools library, and monads. 2nd ed., Packt Publishing, Birmingham. • Lutz, M. (2013): Learning Python. 5th ed., O'Reilly, Sebastopol, CA. • Phillips, D. (2018): Python 3 object-oriented programming: Build robust and maintainable software with object-oriented design patterns in Python 3.8. 3rd ed., Packt Publishing, Birmingham. • Ramalho, L. (2015): Fluent Python: Clear, concise, and effective programming. O'Reilly, Sebastopol, CA.
Other Learning Resources	See MyCampus platform.

Course Descriptors
June 2022

Mathematics: Linear Algebra

COURSE DESCRIPTOR

Module name	Mathematics: Linear Algebra
Course name	Mathematics: Linear Algebra
Level	4
Course Code	DLBDSMFLA
Credit Value	10 UK Credits
Study-load	Contact hours: 30h Self test: 30h Student managed learning hours: 90h
Pre-requisites	None
Co-requisites	None
Dis-requisites	None
Course leader	Prof. Dr. Robert Graf
Module content outline	Linear algebra is a fundamental subject in mathematics. Its historical origin lies in the development of solution techniques for systems of linear equations arising from geometric problems. Numerous scientific and engineering applications can be solved using its methods. This course introduces the foundations of linear algebra and its basic notions like vectors and matrices. It then builds upon this foundation by introducing the derivation of solution techniques for problems in analytical geometry.
Course aims	This course introduces the foundations of linear algebra and its basic notions like vectors and matrices. It then builds upon this foundation by introducing the derivation of solution techniques for problems in analytical geometry.
Learning Outcomes	Having completed this module, students will be able to • explain fundamental notions in the domain of linear equation systems. exemplify properties of vectors and vector spaces. • summarize characteristics of linear and affine mappings. • identify important relations in analytical geometry. • utilize different methods for matrix decomposition.
Careers/Graduate destinations	Entry to mid level positions with administrative tasks.
Teaching and learning methods	Contact hours includes the following: (please click on the checkboxes as appropriate) ☒ Lectures ☐ Group Work: ☐ Seminars ☒ Tutorial ☐ Laboratory ☐ Workshops ☐ Practical ☒ VLE Activities
Indicative content	1. Fundamentals

	1.1 Systems of linear equations 1.2 Matrices as compact representations of linear equations 1.3 Matrix algebra 1.4 Inverse and trace 2. Vector Spaces 2.1 Definition 2.2 Linear combination and linear dependence 2.3 Base, span, and rank 3. Linear and affine mappings 3.1 Matrix representations of linear mappings 3.2 Image and kernel 3.3 Affine spaces and sub-spaces 3.4 Affine mappings 4. Analytical Geometry 4.1 Norms 4.2 Inner and dot product 4.3 Orthogonal projections 4.4 Rotations 5. Matrix Decomposition 5.1 Determinant and trace 5.2 Eigenvalues and eigenvectors 5.3 Cholesky decomposition 5.4 Eigenvalue decomposition and diagonalisation 5.5 Singular value decomposition
Assessment method	Formative assessment: Summative assessment: Exam (100% - 90min) At IU formative assessment is informal and done within class. This practice of the summative assessment does not impact on the final summative assessment grade. This practice opportunity familiarises students with the assessment type and provides formative feedback that students can use for their final assessment. Formative assessment is also used as part of the process of supporting students reflect on their own learning. This course offers several practice exams.
Reading list	Required reading: See IU coursebook on Mathematics: Linear Algebra. Additional reading (optional): • Mathai, A. M., & Haubold, H. J. (2017). Linear algebra, a course for physicists and engineers (1st ed.) De Gruyter. • Neri, F. (2019). Linear algebra for computational sciences and engineering (2nd ed.) Springer. ▪ Shilov, G. E. (1977). Linear algebra. Dover Publications. • Strang, G. (2020). Introduction to linear algebra. (5th ed.) Cambridge Press.
Other Learning Resources	See MyCampus platform.

Course Descriptors
June 2022

Intercultural and Ethical Decision-Making

COURSE DESCRIPTOR

Module name	Intercultural and Ethical Decision-Making
Course name	Intercultural and Ethical Decision-Making
Level	4
Course Code	DLBCSIDM
Credit Value	10 UK Credits
Study-load	Contact hours: 20h Tutorial 20h Student managed learning hours: 110h
Pre-requisites	None
Co-requisites	None
Dis-requisites	None
Course leader	Prof. Dr. Jürgen Matthias Seeler
Module content outline	In this course, students acquire the necessary knowledge to understand intercultural competencies and current developments in the fields of diversity and ethics. Students will understand how to systematically plan and implement learning processes for the development of competences important in these areas. First, important terms are clarified and differentiated from each other, and cultural aspects are explained from different perspectives. In addition, students learn that cultural issues are relevant at different levels, for example, within a state, company, or other group. In this context, students also recognize the connection between ethics and culture with different interdependencies. On the basis of this knowledge, students are then familiarized with the different possibilities and potentials of intercultural and ethical learning and working. Practical cases are used to illustrate the importance of the relationships learned for today's work context in many companies. The students then work on a case study in which the acquired knowledge is systematically applied.
Course aims	In this course, students acquire the necessary knowledge to understand intercultural competencies and current developments in the fields of diversity and ethics. Students will understand how to systematically plan and implement learning processes for the development of competences important in these areas.
Learning Outcomes	Having completed this module, students will be able to • Explain the most important terms in the areas of interculturality, diversity, and ethics. • Distinguish different explanatory patterns of culture. • Understand culture at different levels. • Plan processes of intercultural learning and working.

	• Understand the interdependencies of culture and ethics. • Independently work on a case study on intercultural competence.
Careers/Graduate destinations	Entry to mid level.
Teaching and learning methods	Contact hours includes the following: (please click on the checkboxes as appropriate) ☒ Lectures ☐ Group Work: ☐ Seminars ☒ Tutorial ☐ Laboratory ☐ Workshops ☐ Practical ☒ VLE Activities
Indicative content	1. Basics of Intercultural and Ethical Competence to Act 1.1 Subject Areas, Terms, and Definitions 1.2 Relevance of Intercultural and Ethical Action 1.3 Intercultural Action - Diversity, Globalization, Ethics 2. Cultural Concepts 2.1 Hofstedes Cultural Dimensions 2.2 Culture Differentiation According to Hall 2.3 Locus of Control Concept to Rotter 3. Culture and Ethics 3.1 Ethics - Basic Terms and Concepts 3.2 Interdependence of Culture and Ethics 3.3 Ethical Concepts in Different Regions of the World 4. Current Topics in the Area of Interculturality, Ethics, and Diversity 4.1 Digital Ethics 4.2 Equality and Equal Opportunities 4.3 Social Diversity 5. Intercultural Learning and Working 5.1 Acculturation 5.2 Learning and Working in Intercultural Groups 5.3 Strategies for Dealing with Cultural Conflicts 6. Case Studies for Cultural and Ethical Conflicts 6.1 Case Study: Interculturality 6.2 Case Study: Diversity 6.3 Case Study: Interculturality and Ethics
Assessment method	Formative assessment: Summative assessment: Case Study (100%) At IU formative assessment is also informal and done within class. This practice of the summative assessment does not impact on the final summative assessment grade. This practice opportunity familiarises students with the assessment type and provides formative feedback that students can use for their final assessment. Formative assessment is also used as part of the process of supporting students reflect on their own learning. This course offers several practice exams.

Reading list	Required reading: See IU coursebook on Intercultural and Ethical Decision-Making. Additional reading (optional): • Boylan, M. (Eds.). (2014). Business Ethics. (2nd ed.). Wiley-Blackwell. • Thomas, A., Kinast. E. U., Schroll-Machl, S. (Eds.) (201): Handbook of intercultural communication and cooperation. Basics and areas of application. Vandenhoeck & Ruprecht.
Other Learning Resources	See MyCampus platform.

Course Descriptors
June 2022

Statistics - Inferential Statistics

COURSE DESCRIPTOR

Module name	Statistics - Inferential Statistics
Course name	Statistics - Inferential Statistics
Level	4
Course Code	DLBDSSIS
Credit Value	10 UK Credits
Study-load	Contact hours: 30h Self study: 30h Student managed learning hours: 90h
Pre-requisites	DLBDSSPDS01
Co-requisites	None
Dis-requisites	None
Course leader	Dr. Stefan Stöckl
Module content outline	Statistical analysis and understanding are the foundations of data-driven methods and machine learning approaches. This course gives a thorough introduction to point estimators and discusses various techniques to estimate and optimize parameters. Special focus is given to a detailed discussion of both statistical and systematic uncertainties as well as propagation of uncertainties. Bayesian statistics is fundamental to data-driven approaches, and this course takes a close look at Bayesian techniques such as Bayesian parameter estimation and prior probability functions. Furthermore, this course gives an in-depth overview of statistical testing and decision theory, focusing on aspects such as A/B testing, hypothesis testing, p-values, and multiple testing which are fundamental to statistical analysis approaches in a broad range of practical applications.
Course aims	This course gives an in-depth overview of statistical testing and decision theory, focusing on aspects such as A/B testing, hypothesis testing, p-values, and multiple testing which are fundamental to statistical analysis approaches in a broad range of practical applications.
Learning Outcomes	Having completed this module, students will be able to • understand point estimation methods. • apply maximum likelihood and ordinary least squares method to estimate parameters. comprehend the concept of statistical and systematic errors. • employ error propagation methods. • utilize Bayesian inference and non-parametric techniques. • evaluate statistical tests. • grasp the fundamentals of statistical decision theory.

Careers/Graduate destinations	Entry to mid level positions with administrative tasks.
Teaching and learning methods	Contact hours includes the following: (please click on the checkboxes as appropriate) ☒ Lectures ☐ Group Work: ☐ Seminars ☒ Tutorial ☐ Laboratory ☐ Workshops ☐ Practical ☒ VLE Activities
Indicative content	1. Point Estimation 1.1 Method of moments 1.2 Sufficient statistics 1.3 Maximum likelihood 1.4 Ordinary least squares 1.5 Resampling techniques 2. Uncertainties 2.1 Statistical and systematic uncertainties 2.2 Propagation of uncertainties 3. Bayesian Inference & Non-parametric Techniques 3.1 Bayesian parameter estimation 3.2 Prior probability functions 3.3 Parzen windows 3.4 K-nearest-neighbours 4. Statistical Testing 4.1 A/B testing 4.2 Hypothesis tests & test statistics 4.3 P-values & confidence intervals 4.4 Multiple testing 5. Statistical Decision Theory 5.1 The risk function 5.2 Maximum likelihood, Minimax, and Bayes 5.3 Admissibility and Stein's paradox
Assessment method	Formative assessment: Summative assessment: Exam (100% - 90min) At IU formative assessment is informal and done within class. This practice of the summative assessment does not impact on the final summative assessment grade. This practice opportunity familiarises students with the assessment type and provides formative feedback that students can use for their final assessment. Formative assessment is also used as part of the process of supporting students reflect on their own learning. This course offers several practice exams.
Reading list	Required reading: See IU coursebook on Statistics – Inferential Statistics. Additional reading (optional): • Wasserman, L. (2004). All of statistics: A concise course in statistical inference. Springer.

	• Downey, A. B. (2014). Think stats (2nd ed.). O'Reilly. • Downey, A.B. (2013). Think bayes. O'Reilly.
Other Learning Resources	See MyCampus platform.

Course Descriptors
June 2022

Introduction to Financial Services Sector

COURSE DESCRIPTOR

Module name	Fundamentals of Finance and Banking
Course name	Introduction to Financial Services Sector
Level	4
Module Code	LIBFBBAEFFB
Course Code	LIBFBBAEFFB01
Credit Value	15 UK Credits
Programmes	• BSc Business Administration with Finance • BSc Data Science with Finance • BSc International Management with Finance
Study-load	Contact hours: 25 Student managed learning hours: 125
Pre-requisites	None
Co-requisites	None
Dis-requisites	None
Course leader	Name: TBD Email: TBD
Course Overview	This is an introductory module that exposes you to key forces driving change in the financial services industry. The module is designed to provide an introduction to the environment within which the financial services industry operates and to explore the main components of the financial system. Traditionally, banks have been acting as intermediaries between borrowers and lenders, but changes to this model have generated expansion of the industry as well as increased risks. Several main players are considered, namely the central bank, commercial banks, retail banks, global investment banks, asset managers, hedge funds, insurance companies, private wealth managers, brokers, stock exchanges, and regulators.
Learning Outcomes	Having completed this module, students will be able to • LO1: Demonstrate knowledge and understanding of financial institutions and identify the different types of services that they provide to meet the needs of their customers • LO2: Explain the issues that arise in the intermediation and disintermediation of banks • LO3: Discuss the types of risk that affect financial institutions and how to mitigate them • LO4: Discuss current issues in the financial services sector

Teaching and learning methods	Contact hours includes the following: (please click on the checkboxes as appropriate) ☒ Lectures ☐ Group Work: ☐ Seminars ☒ Tutorial ☐ Laboratory ☐ Workshops ☐ Practical ☒ VLE Activities
Indicative content	1) History of banking a) Money b) Development of banking system 2) Deposit-taking and non-deposit taking financial institutions a) Depository (eg banks, building societies) b) non-depository (eg pension funds, unit trusts, insurance companies) c) financial intermediaries and the products they deal in d) non-marketable securities 3) Central banks a) Structure b) Functions c) Comparison of world central banks 4) Capital markets a) Financial markets – and the products they deal in b) marketable securities 5) Interest rates and derivatives a) The important relationship between risk, term and return b) Market participants 6) Current developments a) Wider societal implications are considered e.g. financial inclusion, fossil fuels/extractive industries finance b) Socially Responsible Investments and Environmental, Societal and Governance issues
Assessment method	Assessment Type Code: Exam Weighting %: 40% Submission week: n/a Length: 90min The Pass mark for the course and each component is 40%. Formative: individual and group throughout the course Summative: weighted components above NB Assignments should be research based and assessed based on the quality of that research and strength of understanding of the current dynamic of the market
Reading list	Introduction to Banking: Barbara Casu, Claudia Girardone, Philip Molyneux. Pearson Higher Ed, 17 Apr 2015 Industry reports and industry conference proceedings (online) as directed (updated in each iteration). Other general reading as directed by the module lead.
Other Learning Resources	See MyCampus platform.

Course Descriptors
June 2022

Introduction to Banking Law, Regulation and Ethics

COURSE DESCRIPTOR

Module name	Fundamentals of Finance and Banking
Course name	Introduction to Banking Law, Regulation and Ethics
Level	4
Module Code	LIBFBBAEFFB
Course Code	LIBFBBAEFFB02
Credit Value	15 UK Credits
Programmes	• BSc Business Administration with Finance • BSc Data Science with Finance • BSc International Management with Finance
Study-load	Contact hours: 25 Student managed learning hours: 125
Pre-requisites	None
Co-requisites	None
Dis-requisites	None
Course leader	Name: TBD Email: TBD
Course Overview	This is an introductory module that provides an overview of banking law and regulation. This covers private commercial law developed through banking custom, standards of good practice, and the common law. Consumer protection is at the centre of many banking law and regulatory requirements. This module also considers the how firms operate according to ethical values, and demonstrates how governance, strategy and decision making has been informed by ethical principles.
Learning Outcomes	Having completed this module, students will be able to • LO1: Demonstrate an understanding of the key elements of law relating to banking. • LO2: Explain the reasons for regulation of the financial services industry and the key principles of that regulation, including both statutory and self-regulation. • LO3: Demonstrate awareness and understanding of current issues in the banking environment including those relating to ethics and Codes of Conduct. • LO4: Discuss current regulatory issues in the financial services sector
Teaching and learning methods	Contact hours includes the following: (please click on the checkboxes as appropriate) ☒ Lectures ☐ Group Work: ☐ Seminars ☒ Tutorial

	☐ Laboratory ☐ Workshops ☐ Practical ☒ VLE Activities
Indicative content	1) 1) Legal basis of banking a) Legal issues b) Contract Law 2) The banking universe a) The world's largest banks b) Types of banks c) The payments system 3) The global financial crisis a) Causes b) Aftermath c) Response 4) Ethics in banking a) What is ethics? b) Business ethics c) Ethical banking 5) Regulation and professional code of conduct a) Regulators b) Professional bodies c) Supervision accords 6) Risk a) Credit risk b) Market risk c) Operational risk d) Liquidity risk e) Reputational risk 7) Current developments a) Challengers b) Fintech
Assessment method	Assessment Type Code: Exam Weighting %: 40% Submission week: n/a Length: 90min The Pass mark for the course and each component is 40%. Formative: individual and group throughout the course Summative: weighted components above NB Assignments should be research based and assessed based on the quality of that research and strength of understanding of the current dynamic of the market
Reading list	Introduction to Banking: Barbara Casu, Claudia Girardone, Philip Molyneux. Pearson Higher Ed, 17 Apr 2015 Industry reports and industry conference proceedings (online) as directed (updated in each iteration). Other general reading as directed by the module lead.

Other Learning Resources	See MyCampus platform.

3rd semester

Course Descriptors
June 2022

Database Modeling and Database Systems

COURSE DESCRIPTOR

Module name	Database Modelling and Database Systems
Course name	Database Modelling and Database Systems
Level	5
Course Code	DLBCSDMDS
Credit Value	10 UK Credits
Study-load	Contact hours: 30h Self test: 30h Student managed learning hours: 90h
Pre-requisites	None
Co-requisites	None
Dis-requisites	None
Course leader	Prof. Dr. Ralf Kneuper
Module content outline	Stored data form the basis of many value chains of an information and knowledge society. The methodical structuring of data through data schemas therefore forms an important basis for storing information in such a way that it can be retrieved and processed quickly and easily. In addition to the structured storage of data, structured access to large amounts of data must also be possible. This course teaches students how to store data in relational data models and how to access stored data with SQL. In addition to relational database systems, modern DB systems (NoSQL) for storing and accessing data will be presented.
Course aims	This course teaches students how to store data in relational data models and how to access stored data with SQL. In addition to relational database systems, modern DB systems (NoSQL) for storing and accessing data will be presented.
Learning Outcomes	Having completed this module, students will be able to ▪ describe the basic concepts of the relational data model and distinguish them from each other. ▪ visually model data schemas. ▪ know SQL queries, read data from databases, change the data stock, and have experience in their use. ▪ design, create, and modify SQL queries and data schemas for SQL databases, and have experience using them. ▪ independently design database schemas and create database queries to solve concrete problems. ▪ know the most important NoSQL concepts and distinguish them from each other.
Careers/Graduate destinations	Entry to mid level positions with administrative tasks.

Teaching and learning methods	Contact hours includes the following: (please click on the checkboxes as appropriate) ☒ Lectures ☐ Group Work: ☐ Seminars ☒ Tutorial ☐ Laboratory ☐ Workshops ☐ Practical ☒ VLE Activities
Indicative content	1. Fundamentals of Relational Databases 1.1 Basic Concepts of the Relational Data Model 1.2 Find and Delete Records in the Database 1.3 SQL and Relational Database Systems 2. Querying Data from a Single Table 2.1 Query Data (SELECT) 2.2 Query Data With Condition (WHERE) 2.3 Sort Query Output (ORDER BY) 2.4 Queries With Group Formation (GROUP BY) 2.5 Subqueries With Nested SELECT Statements 3. Conception and Modeling of Relational Databases 3.1 The Entity Relationship Model 3.2 Relationships and Cardinalities in E/R Models 3.3 Normal Forms of Databases 4. Creation of Relational Databases 4.1 Logical Database Design Activities 4.2 Mapping of the Conceptual Data Model into the Physical Data Model 4.3 Generation of Tables in SQL Databases from E/R Diagrams 5. Complex Database Queries on Multiple Tables 5.1 Composite Quantities (JOIN) 5.2 Set Operations 5.3 Data Views With CREATE VIEW 6. Manipulating Records in Databases 6.1 Insert New Data Records (INSERT) 6.2 Change Existing Records 6.3 Transactions 7. NoSQL Database Systems 7.1 Motivation and Basic Idea 7.2 Selected Groups of NoSQL Systems
Assessment method	Formative assessment: Summative assessment: Exam (90min) At IU formative assessment is informal and done within class. This practice of the summative assessment does not impact on the final summative assessment grade. This practice opportunity familiarises students with the assessment type and provides formative feedback that students can use for their final assessment. Formative assessment

	is also used as part of the process of supporting students reflect on their own learning. This course offers several practice exams.
Reading list	Required reading: See IU coursebook on Database Modeling and Database Systems. Additional reading (optional): • 46th VLDB (2020). Proceedings of the International Conference on Very Large Data Bases (VLDB). • Date, C.J. (2019). Database design and relational theory: Normal forms and all that jazz (2nd ed.). Apress. • Documentation of Mondial Database (2010). Mondial Database. • Elmasri, R., Navathe, S. B. (2016). Fundamentals of database systems. Pearson Education Limited. • Foster, E., Godbole, S. (2016). Database systems. A pragmatic approach. (2nd ed.). Apress. • Sumathi, S. et al (2010). Fundamentals of relational database management systems. Springer. • W3Schools (2020). SQL Tutorial.
Other Learning Resources	See MyCampus platform.

Course Descriptors
June 2022

Project: Build a Data Mart in SQL

COURSE DESCRIPTOR

Module name	Project: Build a Data Mart in SQL
Course name	Project: Build a Data Mart in SQL
Level	5
Course Code	DLBDSPBDM
Credit Value	10 UK Credits
Study-load	Contact hours: 30h Student managed learning hours: 120h
Pre-requisites	None
Co-requisites	None
Dis-requisites	None
Course leader	Sharam Dadashnia
Module content outline	This course provides the opportunity to implement a realistic database use case scenario. A list of use case ideas is provided on the online learning platform. In addition, the students can contribute use case ideas of their own in accord with the tutor. The core aim is to apply the hitherto theoretical knowledge of database methods and approaches to solve a real-world application scenario. This entails reasoning about possible design and architectural choices in a rational way, as well as implementing them in a functioning database system.
Course aims	The core aim is to apply the hitherto theoretical knowledge of database methods and approaches to solve a real-world application scenario.
Learning Outcomes	Having completed this module, students will be able to • transfer previously-acquired knowledge about database methods and approaches to practical use cases. • design, architect, and implement a working data-mart solution. • reason about design choices of and trade-offs between relevant implementation alternatives. • critically evaluate said choices with respect to the stated design goal. • describe and explain the resulting solution.
Careers/Graduate destinations	Entry to mid level positions with administrative tasks.
Teaching and learning methods	Contact hours includes the following: (please click on the checkboxes as appropriate) ☒ Lectures ☐ Group Work: ☐ Seminars ☒ Tutorial ☐ Laboratory ☐ Workshops

	☐ Practical ☒ VLE Activities
Indicative content	In this course, students apply their knowledge of data modeling and databases to implement a project use case of their choosing. All relevant artefacts, like use case evaluation, chosen implementation method, code, and outcomes, are documented in the form of a written project report.
Assessment method	Formative assessment: Portfolio (100%) Summative assessment: At IU formative assessment is also informal and done within class. This practice of the summative assessment does not impact on the final summative assessment grade. This practice opportunity familiarises students with the assessment type and provides formative feedback that students can use for their final assessment. Formative assessment is also used as part of the process of supporting students reflect on their own learning.
Reading list	Required reading: Additional reading (optional): • Date, C. J. (2012). Database design and relational theory. Sebastopol, CA: O'Reilly. • DeBarros, A. (2018). Practical SQL: A beginner's guide to storytelling with data. San Francisco, CA: No Starch Press. • Harrington, J. L. (2016). Relational database design and implementation (4th ed.). Burlington, MA: Morgan Kaufmann. • Hernandez, M. J. (2013). Database design for mere mortals: A hands-on guide to relational database design (3rd ed.). Boston, MA: Addison-Wesley. • Viescas, J. (2018). SQL queries for mere mortals: A hands-on guide to data manipulation in SQL (4th ed.). Boston, MA: Addison-Wesley.
Other Learning Resources	See MyCampus platform.

Course Descriptors
June 2022

Business Intelligence

COURSE DESCRIPTOR

Module name	Business Intelligence
Course name	Business Intelligence
Level	5
Course Code	DLBDBBI
Credit Value	10 UK Credits
Study-load	Contact hours: 30 Self Test: 30h Student managed learning hours: 90
Pre-requisites	None
Co-requisites	None
Dis-requisites	None
Course leader	Prof. Dr. Sebastian Werning
Module content outline	Business Intelligence (BI) is used to obtain information from company data that is relevant for targeted corporate management and the optimization of business activities. This course introduces and discusses techniques, procedures, and models for data provision, information generation, and analysis, as well the distribution of the information obtained. You will then be able to explain the various subject areas of data warehousing and independently select methods and techniques to meet specific requirements.
Course aims	This course introduces and discusses techniques, procedures, and models for data provision, information generation, and analysis, as well the distribution of the information obtained. You will then be able to explain the various subject areas of data warehousing and independently select methods and techniques to meet specific requirements.
Learning Outcomes	Having completed this module, students will be able to ▪ explain the motivation, use cases, and basics of Business Intelligence. ▪ identify and explain techniques and methods for providing and modeling data, as well as types of data relevant to BI, differentiating between them. ▪ explain techniques and methods for the generation and storage of information and independently select suitable methods on the basis of concrete requirements.
Careers/Graduate destinations	Entry to mid level

Teaching and learning methods	Contact hours includes the following: (please click on the checkboxes as appropriate) ☒ Lectures ☐ Group Work: ☐ Seminars ☒ Tutorial ☐ Laboratory ☐ Workshops ☐ Practical ☒ VLE Activities
Indicative content	1. Motivation and Conceptualization 1.1 Motivation and Historical Development 1.2 BI as a Framework 2. Data Provision 2.1 Operative and Dispositive Systems 2.2 The Data Warehouse Concept 2.3 Architectural Variations 3. Data Warehouse 3.1 ETL Process 3.2 DWH and Data Mart 3.3 ODS and Metadata 4. Modelling of Multidimensional Data Spaces 4.1 Data Modeling 4.2 OLAP Cubes 4.3 Physical Storage 4.4 Star and Snowflake Scheme 4.5 Historicization 5. Analysis Systems 5.1 Free Data Research and OLAP 5.2 Reporting Systems 5.3 Model-Based Analysis Systems 5.4 Concept-Oriented Systems 6. Distribution and Access 6.1 Information Distribution 6.2 Information Access
Assessment method	Formative assessment: Summative assessment: Exam (90min) At IU formative assessment is informal and done within class. This practice of the summative assessment does not impact on the final summative assessment grade. This practice opportunity familiarises students with the assessment type and provides formative feedback that students can use for their final assessment. Formative assessment is also used as part of the process of supporting students reflect on their own learning. This course offers several practice exams.

Reading list	Required reading: See IU coursebook on Business Intelligence Additional reading (optional): ▪ Grossmann, W., & Rinderle-Ma, S. (2015). Fundamentals of business intelligence. Springer. ▪ Kolb, J. (2013). Business intelligence in plain language: A practical guide to data mining and business analytics. Createspace. ▪ Sharda, R., Delen, D., & Turban, E. (2014). Business intelligence and analytics: Systems for decision support. Pearson. ▪ Sherman, R. (2014). Business intelligence guidebook: From data integration to analytics. Morgan Kaufmann. ▪ Vaisman, A., & Zimányi, E. (2016). Data warehouse systems: Design and implementation. Springer. See IU coursebook on Business Intelligence
Other Learning Resources	See MyCampus platform.

Course Descriptors
June 2022

Project: Business Intelligence

COURSE DESCRIPTOR

Module name	Project: Business Intelligence
Course name	Project: Business Intelligence
Level	5
Course Code	DLBCSEBI2
Credit Value	10 UK Credits
Study-load	Contact hours: 30h Student managed learning hours: 120h
Pre-requisites	None
Co-requisites	None
Dis-requisites	None
Course leader	Prof. Dr. Sebastian Werning
Module content outline	Using well-known methods and techniques from the field of Business Intelligence, students will work independently on a practical question in this course. At the end of the course you will be able to independently design and prototype Business Intelligence applications based on concrete requirements.
Course aims	Implementation and documentation of practical questions regarding the use of Business Intelligence applications. Typical scenarios are, for example, “Management of BI projects”, “Design of multidimensional data models” and “Prototypical implementation of small BI applications”.
Learning Outcomes	Having completed this module, students will be able to • independently design a solution to a practical problem in the field of Business Intelligence in order to then implement a prototype and document the results. • identify and explain typical problems and challenges in the design and practical implementation of small BI solutions. •
Careers/Graduate destinations	Entry to mid level
Teaching and learning methods	Contact hours includes the following: (please click on the checkboxes as appropriate) ☒ Lectures ☐ Group Work: ☐ Seminars ☒ Tutorial ☐ Laboratory ☐ Workshops ☐ Practical ☒ VLE Activities

Indicative content	Implementation and documentation of practical questions regarding the use of Business Intelligence applications. Typical scenarios are, for example, “Management of BI projects”, “Design of multidimensional data models” and “Prototypical implementation of small BI applications”.
Assessment method	Formative assessment: Written Assessment: Project Report Summative assessment: At IU formative assessment is also informal and done within class. This practice of the summative assessment does not impact on the final summative assessment grade. This practice opportunity familiarises students with the assessment type and provides formative feedback that students can use for their final assessment. Formative assessment is also used as part of the process of supporting students reflect on their own learning.
Reading list	Required reading: See IU coursebook on Project: Business Intelligence Additional reading (optional): • Christoph Meinel, Hasso Plattner, Larry Leifer (2011): Design Thinking: Understand – Improve – Apply; Springer Berlin Heidelberg • Jeanne Liedtka (2018): Why Design Thinking Works. In: Havard Business Review, Issue: 2018/09, pp.72–79 • Christoph Meinel, Larry J. Leifer (2021): Design Thinking Research: Interrogating the Doing; Springer International Publishing See IU coursebook on Project: Business Intelligence
Other Learning Resources	See MyCampus platform.

Course Descriptors
June 2022

Crypto & Blockchain

COURSE DESCRIPTOR

Module name	Fintech
Course name	Crypto & Blockchain
Level	5
Module Code	LIBFBBAEFT
Course Code	LIBFBBAEFT01
Credit Value	15 UK Credits
Programmes	• BSc Business Administration with Finance • BSc Data Science with Finance • BSc International Management with Finance
Study-load	Contact hours: 30 Student managed learning hours: 120
Pre-requisites	None
Co-requisites	None
Dis-requisites	None
Course leader	Name: TBD Email: TBD
Course Overview	Recent years have seen a proliferation in the number of crypto assets available in the market. This course considers the evolution of money from gold coins through to fiat currencies and into plastic and crypto assets considering the current state of the market and the various principal components thereof.
Learning Outcomes	Having completed this module, students will be able to • LO1. Define money and the role of electronic money in society • LO2. Discuss the merits of crypto assets and the risks involved in holding them • LO3. Analyse and comment on the merits of various crypto assets. • LO4. Discuss the role of CBDCs in society now and into the future
Teaching and learning methods	Contact hours includes the following: (please click on the checkboxes as appropriate) ☒ Lectures ☐ Group Work: ☐ Seminars ☒ Tutorial ☐ Laboratory ☐ Workshops ☐ Practical ☒ VLE Activities
Indicative content	1) The history of Money a) Gold to coin to paper to plastic & contactless b) The three features money has to possess c) Fiat currency, floating and fixed exchange rates

	d) The history and developing roles of central banks 2) Cryptography & Cryptocurrencies a) Encryption b) Bitcoin c) The double spend problem d) The 4 foundations of Bitcoin e) Mining as a business 3) The Blockchain a) How a Bitcoin transaction works b) Blockchain types c) What is a block chain? d) Possible applications of Blockchain e) Proof of work and proof of stake 4) Crypto Assets a) What is a crypto asset? b) Distribution of crypto assets c) Initial Coin Offerings d) ICO versus IPO e) Taxonomy of Crypto assets 5) Non-Fungible Tokens a) Fungible, non-fungible and examples b) Issuing an NFT c) Protocols d) Markets and wallets e) Recent developments in the NFT marketplace f) Other applications of NFT technology
Assessment method	Assessment Type Code: Exam Weighting %: 50% Submission week: n/a Length: 90 min The Pass mark for the course and each component is 40%. Formative: individual and group throughout the course Summative: weighted components above NB Assignments should be research based and assessed based on the quality of that research and strength of understanding of the current dynamic of the market
Reading list	Essential reading for this course is: Arslanian, H. and Fischer, F. (2019) The Future of Finance : the impact of finTech, AI, and crypto on financial services, Palgrave Macmillan US. ProQuest Ebook Central [online]. Available through KnowledgeBank website at: https://study.libf.ac.uk/refer.php?resource=ebookcentral&id=5829325 [Accessed: 16 June 2022]

	Industry reports and industry conference proceedings (online) as directed (updated in each iteration). Other general reading as directed by the course lead. The above-mentioned Essential Reading will be supplemented by a range of other learning resources including e-books, e-journals, online activities, web-based articles, videos, forums and blogs, either freely available or available via KnowledgeBank, as recommended by your course lecturer.
Other Learning Resources	See MyCampus platform.

Course Descriptors
June 2022

Fintech

COURSE DESCRIPTOR

Module name	Fintech
Course name	Fintech
Level	5
Module Code	LIBFBBAEFT
Course Code	LIBFBBAEFT02
Credit Value	15 UK Credits
Programmes	• BSc Business Administration with Finance • BSc Data Science with Finance • BSc International Management with Finance
Study-load	Contact hours: 25 Student managed learning hours: 125
Pre-requisites	None
Co-requisites	None
Dis-requisites	None
Course leader	Name: TBD Email: TBD
Course Overview	Recent years have seen huge increase in the number of technological solutions on offer to individuals and business in finance. From the challenger banks to insurance, asset management, payments and in almost every area of finance there are new offerings appearing frequently. This course covers the main sectors of financial services that are the target of Fintech companies (excluding Crypto assets). We will review the current state of the market and discuss its future direction.
Learning Outcomes	Having completed this module, students will be able to • LO1. Define Fintech and its place in the financial services sector • LO2. Discuss the merits of Fintech and incumbents and how the market is changing • LO3. Analyse and comment on the merits of various fintech offerings. • LO4. Discuss the role of AI in financial services
Teaching and learning methods	Contact hours includes the following: (please click on the checkboxes as appropriate) ☒ Lectures ☐ Group Work: ☐ Seminars ☒ Tutorial ☐ Laboratory ☐ Workshops ☐ Practical ☒ VLE Activities
Indicative content	1) Fintech in context a) Data speed, processing and memory – the history b) The perfect storm – G4, smartphones and the global financial crisis c) The first online banks

	d) The new online banks e) Fintech and the 7 Ps of Marketing 2) Fintech disruptions a) Regulators and their sand boxes b) Payments – faster payments and international payments c) Open banking 3) Challenger banks a) Data on challengers b) What is on offer? c) Incumbent responses 4) Artificial Intelligence a) What is intelligence? b) Narrow and board network intelligence c) Machine learning d) Neural networks and foundation AI e) AI & automation in Fintech 5) Lending a) Personal loans at challenger banks b) SME funding via challenger banks c) Peer to peer lending (curated and direct) d) Online mortgage brokers e) Online mortgages/ equity loans 6) Insurtech & Asset Management a) Insurtech vs Incumbents b) Products on offer – new developments c) Asset management d) Bots vs people e) Developments in risk profiling 7) Regtech and the futures of Fintech a) Regulatory compliance b) Risk management c) Financial Crime d) Identity management e) New developments in Fintech f) Product or platform?
Assessment method	Assessment Type Code: Case Study Weighting %: 50% Submission week: n/a Length: n/a The Pass mark for the course and each component is 40%. Formative: individual and group throughout the course Summative: weighted components above

	NB Assignments should be research based and assessed based on the quality of that research and strength of understanding of the current dynamic of the market
Reading list	Essential reading for this course is: Arslanian, H. and Fischer, F. (2019) The Future of Finance : the impact of finTech, AI, and crypto on financial services, Palgrave Macmillan US. ProQuest Ebook Central [online]. Available through KnowledgeBank website at: https://study.libf.ac.uk/refer.php?resource=ebookcentral&id=5829325 [Accessed: 16 June 2022] Industry reports and industry conference proceedings (online) as directed (updated in each iteration). Other general reading as directed by the course lead. The above-mentioned Essential Reading will be supplemented by a range of other learning resources including e-books, e-journals, online activities, web-based articles, videos, forums and blogs, either freely available or available via KnowledgeBank, as recommended by your course lecturer..
Other Learning Resources	See MyCampus platform.

4th semester

Course Descriptors
June 2022

Machine Learning – Supervised Learning

COURSE DESCRIPTOR

Module name	Machine Learning – Supervised Learning
Course name	Machine Learning – Supervised Learning
Level	5
Course Code	DLBDSMLSL
Credit Value	10 UK Credits
Study-load	Contact hours: 30h Self test: 30h Student managed learning hours: 90h
Pre-requisites	DLBDSMFC01, DLBDSMFLA01, DLBDSSPDS01, DLBDSSIS01
Co-requisites	None
Dis-requisites	None
Course leader	Prof. Dr. Christian Müller-Kett
Module content outline	This course provides a first introduction to the field of machine learning with a focus on supervised learning (i.e., learning from labeled data), where the most commonly used models in regression and classification are introduced. Moreover, the course provides an introduction to the concepts of large margin classifiers and tree structured models.
Course aims	This course provides a first introduction to the field of machine learning with a focus on supervised learning (i.e., learning from labeled data), where the most commonly used models in regression and classification are introduced.
Learning Outcomes	Having completed this module, students will be able to • remember central notions and paradigms of machine learning. • describe the key ideas of regression and pertaining regularization methods. know basic classification techniques. • explain tree structured machine learning models. • understand support vector machines and the related kernel approach.
Careers/Graduate destinations	Entry to mid-level
Teaching and learning methods	Contact hours includes the following: (please click on the checkboxes as appropriate) ☒ Lectures ☐ Group Work: ☐ Seminars ☒ Tutorial

	☐ Laboratory ☐ Workshops ☐ Practical ☒ VLE Activities
Indicative content	1. Introduction to Machine Learning 1.1 Pattern recognition systems 1.2 The machine learning design cycle 1.3 Technical notions of learning and adaptation 1.4 Under- and overfitting 2. Regression 2.1 Linear regression 2.2 Lasso- and ridge Regularization 2.3 Generalized linear models 2.4 Logistic regression 3. Basic Classification Techniques 3.1 K-nearest neighbour 3.2 Naive Bayes 4. Support Vector Machines 4.1 Large margin classification 4.2 The kernel trick 5. Decision & Regression Trees 5.1 Decision & regression trees 5.2 Random forest 5.3 Gradient boosting
Assessment method	Formative assessment: Summative assessment: Exam (90min) At IU formative assessment is informal and done within class. This practice of the summative assessment does not impact on the final summative assessment grade. This practice opportunity familiarises students with the assessment type and provides formative feedback that students can use for their final assessment. Formative assessment is also used as part of the process of supporting students reflect on their own learning. This course offers several practice exams.
Reading list	Required reading: See IU coursebook on Machine Learning – Supervised Learning Additional reading (optional): • Bishop, C. M. (2006). Pattern recognition and machine learning. Springer. • Grus, J. (2019). Data science from scratch: First principles with Python (2nd ed.). O'Reilly. • Mitchell, T. M. (1997). Machine learning. McGraw-Hill. See IU coursebook on Machine Learning – Supervised Learning
Other Learning Resources	See MyCampus platform.

Course Descriptors
June 2022

Machine Learning – Unsupervised Learning and Feature Engineering

COURSE DESCRIPTOR

Module name	Machine Learning – Unsupervised Learning and Feature Engineering
Course name	Machine Learning – Unsupervised Learning and Feature Engineering
Level	5
Course Code	DLBDSMLUSL
Credit Value	10 UK Credits
Study-load	Contact hours: 20h Self test: 20h Student managed learning hours: 110h
Pre-requisites	DLBDSMFC01, DLBDSMFLA01, DLBDSSPDS01, DLBDSSIS01
Co-requisites	None
Dis-requisites	None
Course leader	Prof. Dr. Christian Müller-Kett
Module content outline	This course is concerned with the tools and techniques for unsupervised learning and feature engineering. Unsupervised learning denotes machine learning approaches that can be applied without label information. As such, the aim is to extract patterns or statistical regularities in data, and finding good features is key for the successful application of machine learning models. Therefore, having a solid set of approaches and tools for this task is of crucial importance for any data scientist. This course introduces the most relevant methods and shows how unsupervised learning techniques can be utilized to find robust and meaningful features. By doing so, concepts and techniques are demonstrated by tangible examples which reflect usage of these techniques to generate added value for the society as a whole as opposed to ethical questionable use cases.
Course aims	The aim is to extract patterns or statistical regularities in data, and finding good features is key for the successful application of machine learning models.
Learning Outcomes	Having completed this module, students will be able to • explain the notions of unsupervised learning and feature selection. • recall commonly-applied clustering models. • understand the concept and utility of dimensionality reduction and manifold learning. describe effective approaches to feature engineering. • discuss the methods of automatic feature generation and selection.

	• reflect on societal and sustainability implications of applying the learned skills to different use cases including ethical questions.
Careers/Graduate destinations	Entry to mid level positions
Teaching and learning methods	Contact hours includes the following: (please click on the checkboxes as appropriate) ☒ Lectures ☐ Group Work: ☐ Seminars ☒ Tutorial ☐ Laboratory ☐ Workshops ☐ Practical ☒ VLE Activities
Indicative content	1. Introduction to Unsupervised Machine Learning and Feature Engineering 1.1 Unsupervised machine learning 1.2 Feature engineering 2. Clustering 2.1 K-Means 2.2 Gaussian mixture model clustering 2.3 Hierarchical clustering 3. Dimensionality Reduction 3.1 Principal component analysis 3.2 Multi-dimensional scaling 3.3 Locally linear embedding 4. Feature Engineering 4.1 Numerical features 4.2 Categorial features 4.3 Text features 5. Feature Selection 5.1 Feature importance 5.2 Feature variance 5.3 Correlation matrix 5.4 Recursive feature selection 6. Automated Feature Generation 6.1 Automated feature generation 6.2 Feature engineering versus deep learning
Assessment method	Formative assessment: Written Assessment: Case Study Summative assessment: At IU formative assessment is also informal and done within class. This practice of the summative assessment does not impact on the final summative assessment grade. This practice opportunity familiarises students with the assessment type and provides formative feedback that students can use for their final assessment. Formative assessment is also used as part of the process of supporting students reflect on their own learning. This course offers several practice exams.
Reading list	Required reading: See IU coursebook on Machine Learning – Unsupervised Learning and Feature Engineering

	Additional reading (optional): • Bonaccorso, G. (2019). Hands-on unsupervised learning with Python: Implement machine learning and deep learning models using Scikit-Learn, TensorFlow, and more. Packt Publishing Ltd. • Celebi, M. E., & Aydin, K. (Eds.). (2016). Unsupervised learning algorithms. Springer International Publishing. • Kane, F. (2017). Hands-on data science and Python machine learning. Packt Publishing Ltd. • Patel, A. A. (2019). Hands-on unsupervised learning using Python: How to build applied machine learning solutions from unlabeled data. O'Reilly Media. See IU coursebook on Machine Learning – Unsupervised Learning and Feature Engineering
Other Learning Resources	See MyCampus platform.

Course Descriptors
June 2022

Data Science Software Engineering

COURSE DESCRIPTOR

Course name **Module**	Data Science Software Engineering
Course name	Data Science Software Engineering
Level	5
Course Code	DLBDSDSSE
Credit Value	10 UK Credits
Study-load	Contact hours: 30h Self test: 30 h Student managed learning hours: 90h
Pre-requisites	DLBDSIPWP01, DLBDSOOFPP01 or IOBP
Co-requisites	None
Dis-requisites	None
Course leader	Prof. Dr. Max Pumperla
Module content outline	A core part of data science is creating value from data. This means not only the creation of sophisticated predictive models but also the development of these models according to modern software development principles. This course gives a detailed overview of the relevant methods and paradigms which data scientists need to know in order to develop enterprise-grade models. This course discusses traditional and agile project management techniques, highlighting both the Kanban and Scrum approaches. It explores relevant software development paradigms such as test-driven development, pair programming, mob programming, and extreme programming. Special focus is given to the topic of testing and the consideration of how to bring a model into a production environment.
Course aims	This course gives a detailed overview of the relevant methods and paradigms which data scientists need to know in order to develop enterprise-grade models. This course discusses traditional and agile project management techniques, highlighting both the Kanban and Scrum approaches.
Learning Outcomes	Having completed this module, students will be able to ▪ understand the concept of project management approaches. ▪ apply agile approaches in software development. ▪ create automated software tests. ▪ understand various software development paradigms. ▪ evaluate the necessary steps to bring models into a production environment.

Careers/Graduate destinations	Entry to mid level
Teaching and learning methods	Contact hours includes the following: (please click on the checkboxes as appropriate) ☒ Lectures ☐ Group Work: ☐ Seminars ☒ Tutorial ☐ Laboratory ☐ Workshops ☐ Practical ☒ VLE Activities
Indicative content	1. Traditional Project Management 1.1 Requirements engineering 1.2 Waterfall model 1.3 Rational unified process 2. Agile Project Management 2.1 Criticism of the waterfall model 2.2 Introduction to SCRUM 2.3 Introduction to Kanban 3. Testing 3.1 Why testing? 3.2 Unit trests 3.3 Integration tests 3.4 Performance monitoring 4. Software Development Paradigms 4.1 Test-driven development (TDD) 4.2 Pair programming 4.3 Mob programming 4.4 Extreme programming 5. From Model to Production 5.1 Continuous delivery 5.2 Continuous integration 5.3 Building a scalable environment
Assessment method	Formative assessment: Summative assessment: Exam (90min) At IU formative assessment is informal and done within class. This practice of the summative assessment does not impact on the final summative assessment grade. This practice opportunity familiarises students with the assessment type and provides formative feedback that students can use for their final assessment. Formative assessment is also used as part of the process of supporting students reflect on their own learning. This course offers several practice exams.

Reading list	Required reading: See IU coursebook on Data Science Software Engineering Additional reading (optional): • Brookshear, G., & Brylow, D. (2019). Computer science: An overview. Pearson Education. • Hunt, A., & Thomas, D. (1999). The pragmatic programmer: From journeyman to master. Addison-Wesley. • Martin, R. C. (2008). Clean code. Prentice Hall. • Sammons, A. (2019). Agile project management with Scrum + Kanban 2 In 1: The last 2 approaches you'll need to become more productive and meet your project goals. M & M Limitless. • Stephens, R. (2015). Beginning software engineering. John Wiley & Sons See IU coursebook on Data Science Software Engineering
Other Learning Resources	See MyCampus platform.

Course Descriptors
June 2022

Project: From Model to Production

COURSE DESCRIPTOR

Module name	Project: From Model to Production
Course name	Project: From Model to Production
Level	5
Course Code	DLBDSMTP
Credit Value	10 UK Credits
Study-load	Contact hours: 30h Student managed learning hours: 120h
Pre-requisites	DLBDSDSSE01, DLBDSIPWP01, DLBDSOOFPP01
Co-requisites	None
Dis-requisites	None
Course leader	Prof. Dr. Christian Müller-Kett
Module content outline	This project course will give students hands-on experience in the challenging task of bringing a predictive model into a production environment. Students will need to consider practical aspects such as data storage and processing, as well as constraints such as service availability and the maximum amount of time a model is allowed to run due to external project requirements. Through this course, students will obtain holistic overview of the integration of predictive models into enterprise-grade applications or services.
Course aims	This project course focuses on practical aspects of ensuring that a predictive model can run in a production environment. The students start with a chosen use case and model and then evaluate the requirements which need to be fulfilled so that the model can be used as part of an enterprise application or app. Students need to evaluate requirements in terms of data storage, processing and throughput, and availability of the service, as well as the persistency, serving, and versioning of the model itself. Monitoring the execution of model predictions and raising alerts in cases of operational issues is a core part of building a reliable model pipeline. All relevant artifacts and considerations are documented by the students in a project report.
Learning Outcomes	Having completed this module, students will be able to • understand the challenges of integrating a predictive model into an application or service. evaluate the constraints a project imposes on the execution of a predictive model. analyze the requirements regarding data acquisition, storage, and processing. • identify the necessary monitoring components required for reliable execution of the predictive model.

	• create and design a production environment for storing, accessing, and serving the predictive model.
Careers/Graduate destinations	Entry to mid level
Teaching and learning methods	Contact hours includes the following: (please click on the checkboxes as appropriate) ☒ Lectures ☐ Group Work: ☐ Seminars ☒ Tutorial ☐ Laboratory ☐ Workshops ☐ Practical ☒ VLE Activities
Indicative content	This project course focuses on practical aspects of ensuring that a predictive model can run in a production environment. The students start with a chosen use case and model and then evaluate the requirements which need to be fulfilled so that the model can be used as part of an enterprise application or app. Students need to evaluate requirements in terms of data storage, processing and throughput, and availability of the service, as well as the persistency, serving, and versioning of the model itself. Monitoring the execution of model predictions and raising alerts in cases of operational issues is a core part of building a reliable model pipeline. All relevant artifacts and considerations are documented by the students in a project report.
Assessment method	Formative assessment: Summative assessment: Oral Project Report At IU formative assessment is also informal and done within class. This practice of the summative assessment does not impact on the final summative assessment grade. This practice opportunity familiarises students with the assessment type and provides formative feedback that students can use for their final assessment. Formative assessment is also used as part of the process of supporting students reflect on their own learning.
Reading list	Required reading: See IU coursebook on Project: From Model to Production Additional reading (optional): • Geron, A. (2017). Hands-on machine learning with Scikit-Learn and TensorFlow. Sebastopol, CA: O'Reilly Publishing. • Karau, H., Konwinski, A., Wendell, A., & Zaharia, M. (2015). Learning spark: Lightning-fast data analysis. Sebastopol, CA: O'Reilly Publishing. • Kleppmann, M. (2017). Designing data-intensive Aapplications: The big ideas behind reliable, scalable, and maintainable systems. Sebastopol, CA: O'Reilly Publishing. • Kuhn, M., & Johnson, K. (2013). Applied predictive modeling. New York, NY: Springer. • Maydanchik, A. (2007). Data quality assessment. Denville, NJ: Technics Publications. • Müller, A., & Guido, S. (2016). Introduction to machine learning with Python: A guide for data scientists. Boston, MA: O'Reilly.

	• Narkhede, N., Shapira, G., & Palino, T. (2017). Kafka: The definitive guide: Real-time data and stream processing at scale. Sebastopol, CA: O'Reilly Publishing. • Psaltis, A. (2017). Streaming data: Understanding the real-time pipeline. Shelter Island, NY: Manning Publications. • White, T. (2015). Hadoop: The definitive guide: Storage and analysis at Internet scale. Sebastopol, CA: O'Reilly Publishing. See IU coursebook on Project: From Model to Production
Other Learning Resources	See MyCampus platform.

Course Descriptors
June 2022

Agile Project Management

COURSE DESCRIPTOR

Module name	Agile Project Management
Course name	Agile Project Management
Level	6
Course Code	DLBCSAPM
Credit Value	10 UK Credits
Study-load	Contact hours: 30 Student managed learning hours: 120
Pre-requisites	None
Co-requisites	None
Dis-requisites	None
Course leader	Prof. Dr. Inga Schlömer (Agile Project Management)
Module content outline	Students will receive a practical introduction to agile project management in this course. In addition to teaching its individual basic principles, the differences between agile project management and plan-driven project management will be examined in detail. In order to understand and experience agile project management, the values, activities, roles, and artefacts of typical agile procedures are presented using Scrum and then practiced on an example project.
Course aims	In this course, students are taught action competences in the field of agile project management. They will be familiarized with the values, activities, roles, and artifacts of agile procedures using Scrum as an example.
Learning Outcomes	Having completed this module, students will be able to • explain the differences between agile and plan-driven project management. • explain agile principles. • work together in an agile manner according to the values defined in Scrum. • apply the activities defined in Scrum. • take responsibility for the roles defined in Scrum. • create and maintain the artefacts defined in Scrum. • consider the increasing relevance of international, intercultural and virtual collaboration in projects.
Careers/Graduate destinations	Entry to mid-level positions with managerial responsibilities.
Teaching and learning methods	Contact hours includes the following: (please click on the checkboxes as appropriate) ☐ Lectures ☐ Group Work: ☒ Seminars ☒ Tutorial

	☐ Laboratory ☐ Workshops ☒ Practical ☒ VLE Activities
Indicative content	This course teaches students various skills in the field of agile project management. In contrast to plan-driven project management, the principles of agility used in modern software development are taught. Using the example of Scrum, students will acquire skills in applying an agile approach, and then apply their knowledge of respective roles and activities in a simple project to gain initial practical experience, documenting it in a project report. The content of the projects results from the individual abilities and requirements of the students.
Assessment method	Formative assessment: Summative assessment: Project Report (Project Report: 7-10 pages for the main body of the text*) Weighting: 100% At IU formative assessment is also informal and done within class. This practice of the summative assessment does not impact on the final summative assessment grade. This practice opportunity familiarises students with the assessment type and provides formative feedback that students can use for their final assessment. Formative assessment is also used as part of the process of supporting students reflect on their own learning. * The main body of the text includes the introduction, main text and conclusion The following components are therefore excluded: - Title page - Table of contents - List of images and/or tables - List of abbreviations - List of appendices - Appendices and further material - Bibliography
Reading list	Required reading: See IU coursebook on Agile Project Management. • Apress.Agile Alliance (2021). Subway Map to Agile Practices. (URL: https:// www.agilealliance.org/agile101/subway-map-to-agile-practices/ [last accessed on 23.06.2021]). • Beck, K. et al. (2001). Manifesto for Agile Software Development. (URL: https:// • agilemanifesto.org/ [last accessed on 23.06.2021]). • Chovanova, H. et al. (2020). Agile Project Management — What is It?:IEEE. In 18th International Conference on Emerging eLearning Technologies and Applications (ICETA), Emerging eLearning Technologies and Applications (ICETA), 2020 18th International Conference. • Dalton, Jeff (2019). Great Big Agile. An OS for Agile Leaders.

	• Douglass, B. P. (2016). Agile systems engineering. Morgan Kaufmann, p. 151-160 • Project Management Institute (2017). Agile Practice Guide. Project Management Institute. • Measey P./Radtac (2015). Agile Foundations -Principles, Practices and Frameworks. BCS The Chartered Institute for IT, p. 131-140, p. 148-152. • Schwaber, K./Sutherland, J. (2020). The Scrum Guide. (URL: https://scrumguides.org/docs/ • scrumguide/v2020/2020-Scrum-Guide-US.pdf#zoom=100 [last accessed on 23.06.2021])
Other Learning Resources	See MyCampus platform.

Course Descriptors
June 2022

Big Data Technologies

COURSE DESCRIPTOR

Module name	Big Data Technologies
Course name	Big Data Technologies
Level	5
Course Code	DLBDSBDT
Credit Value	10 UK Credits
Study-load	Contact hours: 30 Student managed learning hours: 90 Self-Test: 30
Pre-requisites	DLBCSDMDS01
Co-requisites	None
Dis-requisites	
Course leader	Name: Prof. Dr. Christian Müller-Kett
Module content outline	Data are often considered the "new oil", the raw material from which value is created. To harness the power of data, the data need to be stored and processed on a technical level. This course introduces the four "Vs" of data, as well as typical data sources and types. The course discusses the most common data storage formats encountered in modern systems, focusing both on text-based as well as binary data formats. Handling large amounts of data poses significant challenges for the underlying infrastructure. The course discusses the most important distributed and streaming data handling frameworks which are used in leading edge applications.
Course aims	This course introduces the four "Vs" of data, as well as typical data sources and types. The course discusses the most common data storage formats encountered in modern systems, focusing both on text- based as well as binary data formats. The course discusses also the most important distributed and streaming data handling frameworks which are used in leading edge applications.
Learning Outcomes	Having completed this module, students will be able to ▪ name types and sources of data. ▪ understand text-based and binary data formats. ▪ analyze the requirements and constraints of distributed analysis systems. ▪ evaluate the applications of streaming frameworks. describe the motivation for NoSQL data stores and categorize pertaining established concepts.

Careers/Graduate destinations	Entry to mid level positions
Teaching and learning methods	Contact hours includes the following: (please click on the checkboxes as appropriate) ☒ Lectures ☐ Group Work: ☐ Seminars ☒ Tutorial ☐ Laboratory ☐ Workshops ☐ Practical ☒ VLE Activities
Indicative content	1. Data Types and Data Sources 1.1 The 4Vs of data: volume, velocity, variety, veracity 1.2 Data sources 1.3 Data types 2. Text-Based and Binary Data Formats 2.1 Simple formats: CSV, YAML 2.2 XML 2.3 JSON 2.4 Hierarchical data format 5 (HDF 5) 2.5 Apache Parquet 2.6 Apache Arrow 3. NoSQL data stores 3.1 Introduction and motivation 3.2 Approaches and technical concepts 4. Distributed Systems 4.1 Hadoop & MapReduce 4.2 Hadoop file system (HDFS) 4.3 Spark 4.4 DASK 5. Streaming Frameworks 5.1 Spark streaming 5.2 Kafka
Assessment method	Formative assessment: Summative assessment: Exam (90min) At IU formative assessment is informal and done within class. This practice of the summative assessment does not impact on the final summative assessment grade. This practice opportunity familiarises students with the assessment type and provides formative feedback that students can use for their final assessment. Formative assessment is also used as part of the process of supporting students reflect on their own learning. This course offers several practice exams.

Reading list	Required reading: See IU coursebook on Big Data Technologies Additional reading (optional): ▪ Karau, H., Konwinski, A., Wendell, A., & Zaharia, M. (2015). Learning spark: Lightning-fast data analysis. Sebastopol, CA: O'Reilly. ▪ Kleppmann, M. (2017). Designing data-intensive applications: The big ideas behind reliable, scalable, and maintainable systems. Sebastopol, CA: O'Reilly. ▪ Narkhede, N., Shapira, G., & Palino, T. (2017). Kafka: The definitive guide: Real-time data and stream processing at scale. Sebastopol, CA: O'Reilly. ▪ Psaltis, A. (2017). Streaming data: Understanding the real-time pipeline. Shelter Island, NY: Manning. ▪ White, T. (2015). Hadoop: The definitive guide: Storage and analysis at Internet scale. Sebastopol, CA: O'Reilly. See IU coursebook on Big Data Technologies
Other Learning Resources	See MyCampus platform.

5th semester

Course Descriptors
June 2022

Foreign Exchange Exposure and its Management

COURSE DESCRIPTOR

Module name	International Finance
Course name	Foreign Exchange Exposure and its Management
Level	6
Module Code	LIBFBBAEIF
Course Code	LIBFBBAEIF01
Credit Value	15 UK Credits
Programmes	• BSc Business Administration with Finance • BSc Data Science with Finance • BSc International Management with Finance
Study-load	Contact hours: 30 Student managed learning hours: 120
Pre-requisites	None
Co-requisites	None
Dis-requisites	None
Course leader	Name: TBD Email: TBD
Course Overview	The financial management of multinational enterprises (MNEs), i.e., corporations with operations in more than one country whose business is conducted via branches, subsidiaries, or joint-ventures, is quite challenging, particularly in terms of currency risk. This course examines international corporate finance within the context of understanding foreign exchange markets and the management of foreign exchange exposures.
Learning Outcomes	Having completed this module, students will be able to • LO1. Appreciate the challenges of managing MNEs in the context of currency exposure and hedging techniques. • LO2. Understand the foreign exchange market and exchange rate determination. • LO3. Be able to critically analyse methods to manage foreign exchange exposures of MNEs.
Teaching and learning methods	Contact hours includes the following: (please click on the checkboxes as appropriate) ☒ Lectures ☐ Group Work: ☐ Seminars ☒ Tutorial ☐ Laboratory ☐ Workshops ☐ Practical ☒ VLE Activities
Indicative content	• Foreign exchange (FX) markets and exchange rate determination to help understand the key players and their roles and influences on

	exchange rates as well as the key theories around the determination of exchange rates. • International parity conditions looking at impact of inflation on FX rates and the implications from the theory of One Price to relative Purchasing Power Parity for international companies. • Identification of corporate foreign exchange risks to help understand the types of exposure (transaction, translation and operating exposures) and to explore strategies MNEs use to manage FX risks. • Understand hedging techniques from internal through to external hedging methods and to appreciate why corporations take differing hedging strategies for their exposures.
Assessment method	Assessment Type Code: Exam Weighting %: 50% Submission week: n/a Length: 90 min The Pass mark for the course and each component is 40%. Formative: individual and group throughout the course Summative: weighted components above NB Assignments should be research based and assessed based on the quality of that research and strength of understanding of the current dynamic of the market
Reading list	Essential reading for this course is: Eiteman, D.K., Stonehill, A.I. and Moffett, M.H. (2015), Multinational Business Finance. 14th edn. Harlow : Pearson Education Limited The above-mentioned Essential Reading will be supplemented by a range of other learning resources including e-books, e-journals, online activities, web-based articles, videos, forums and blogs, either freely available or available via KnowledgeBank, as recommended by your course lecturer.
Other Learning Resources	See MyCampus platform.

Course Descriptors
June 2022

International Investment Appraisal

COURSE DESCRIPTOR

Module name	International Finance
Course name	International Investment Appraisal
Level	6
Module Code	LIBFBBAEIF
Course Code	LIBFBBAEIF02
Credit Value	15 UK Credits
Programmes	• BSc Business Administration with Finance • BSc Data Science with Finance • BSc International Management with Finance
Study-load	Contact hours: 25 Student managed learning hours: 125
Pre-requisites	None
Co-requisites	None
Dis-requisites	None
Course leader	Name: TBD Email: TBD
Course Overview	This course examines international corporate finance within the context of managing multinational enterprises (MNEs) and controlling international operations, focusing on the global financial environment, financing and investments.
Learning Outcomes	Having completed this module, students will be able to • LO1. Assess the challenges of managing MNEs. • LO2. Assess the opportunities and implications for MNEs debt and equity capital structures • LO3. Appraise the different types of foreign investment undertaken by MNEs. • LO4. Select relevant capital budgeting techniques in the context of MNEs
Teaching and learning methods	Contact hours includes the following: (please click on the checkboxes as appropriate) ☒ Lectures ☐ Group Work: ☐ Seminars ☒ Tutorial ☐ Laboratory ☐ Workshops ☐ Practical ☒ VLE Activities
Indicative content	• Management and control of international operations looking at constraints on management and understanding shareholder v stakeholder wealth maximisation models • Sources of debt and equity raising for MNEs in an international context

	• Transfer pricing and tax legislation to understand differences in tax regimes around the world and the implications for multinational companies as well as the ethical implications surrounding transfer pricing and tax minimisation methods • Foreign Direct Investment (FDI) and international capital budgeting, taking account of the greater complexity of the need to understand wider political risk and tax implications when undertaking financial analysis
Assessment method	Assessment Type Code: Case Study Weighting %: 50% Submission week: n/a Length: n/a The Pass mark for the course and each component is 40%. Formative: individual and group throughout the course Summative: weighted components above NB Assignments should be research based and assessed based on the quality of that research and strength of understanding of the current dynamic of the market
Reading list	Essential reading for this course is: Eiteman, D.K., Stonehill, A.I. and Moffett, M.H. (2015), Multinational Business Finance. 14th edn. Harlow : Pearson Education Limited The above-mentioned Essential Reading will be supplemented by a range of other learning resources including e-books, e-journals, online activities, web-based articles, videos, forums and blogs, either freely available or available via KnowledgeBank, as recommended by your course lecturer.
Other Learning Resources	See MyCampus platform.

Course Descriptors
June 2022

Data Quality and Data Wrangling

COURSE DESCRIPTOR

Module name	Data Quality and Data Wrangling
Course name	Data Quality and Data Wrangling
Level	6
Course Code	DLBDSDQDW
Credit Value	10 UK Credits
Study-load	Contact hours: 20h Self test: 20h Student managed learning hours: 110h
Pre-requisites	DLBDSIPWP01, DLBDSOOFPP01
Co-requisites	None
Dis-requisites	None
Course leader	Name: To be assigned
Module content outline	The goal of data science can be summarized as the extraction of insights (hence, value) from data. It is self-evident that this objective cannot be successfully achieved based on unreliable and untrustworthy data. This course aims at establishing the notion of data quality and the pertinent methods for data quality management. Furthermore, techniques for acquiring data as well as formatting and tidying data in order to make it suitable for subsequent analytical treatment are covered.
Aims	This course aims at establishing the notion of data quality and the pertinent methods for data quality management.
Learning Outcomes	Having completed this module, students will be able to ▪ discuss the fundamental aspects of data quality. ▪ describe common approaches to data quality management. ▪ use various methods to gather data from websites and other public data sources. ▪ work with established data formats. ▪ explain widely-used techniques for data preparation.
Careers/Graduate destinations	Entry to mid level positions
Teaching and learning methods	Contact hours includes the following: (please click on the checkboxes as appropriate) ☒ Lectures ☐ Group Work: ☐ Seminars ☒ Tutorial ☐ Laboratory ☐ Workshops ☐ Practical ☒ VLE Activities

Indicative content	1. Data Quality 1.1 Introduction to data quality 1.2 Data quality dimensions and issue types 2. Data Quality Management 2.1 Data governance and stewardship 2.2 Activities and processes 3. Data Acquisition 3.1 Web scraping 3.2 Data APIs 4. Working with Common Data Formats 4.1 Text-based formats (CSV, XML, JSON) 4.2 Binary formats (HDF 5, Parquet, Arrow) 5. Tidy Data 5.1 Structuring 5.2 Cleansing 5.3 Enrichment
Assessment method	Formative assessment: Summative assessment: Written Assignment At IU formative assessment is also informal and done within class. This practice of the summative assessment does not impact on the final summative assessment grade. This practice opportunity familiarises students with the assessment type and provides formative feedback that students can use for their final assessment. Formative assessment is also used as part of the process of supporting students reflect on their own learning. This course offers several practice exams.
Reading list	Required reading: See IU coursebook on Data Quality and Data Wrangling Additional reading (optional): ▪ King, T., & Schwarzenbach, J. (2020). Managing data quality: A practical guide. BCS. ▪ Loshin, D. (2011). The practitioner's guide to data quality improvement. Morgan Kaufmann. ▪ Maydanchik, A. (2007). Data quality assessment. Technics Publications. ▪ Fürber, C. (2016). Data quality management with semantic technologies (1st ed.). Springer. See IU coursebook on Data Quality and Data Wrangling
Other Learning Resources	See MyCampus platform.

Course Descriptors
June 2022

Explorative Data Analysis and Visualization

COURSE DESCRIPTOR

Module name	Explorative Data Analysis and Visualization
Course name	Explorative Data Analysis and Visualization
Level	6
Course Code	DLBDSEDAV
Credit Value	10 UK Credits
Study-load	Contact hours: 30 Student managed learning hours: 120
Pre-requisites	DLBDSIPWP01, DLBDSOOFPP01
Co-requisites	None
Dis-requisites	None
Course leader	Prof. Dr. Christian Müller-Klett
Module content outline	Obtaining an overview of the salient characteristics of a data set is one of the core activities at the outset of any data analysis endeavour. The corresponding activities, methods, and techniques are grouped under the term “exploratory data analysis”. During exploratory data analysis, gaining insight into a given data set is often aided by the application of suitable visualization techniques. The utility of visualization, however, does not end at this stage; it is also crucial for communicating analytical outcomes. This course first introduces a set of approaches, tools, and techniques that are useful for exploring data sets. It then takes a thorough look at the subject area of visualization, which is presented in detail by an exposition arc that spans from first principles of visualization to practical implementation to insights into the communication of data science results and findings.
Course aims	This course first introduces a set of approaches, tools, and techniques that are useful for exploring data sets. It then takes a thorough look at the subject area of visualization, which is presented in detail by an exposition arc that spans from first principles of visualization to practical implementation to insights into the communication of data science results and findings.
Learning Outcomes	Having completed this module, students will be able to • recognize foundational concepts of exploratory data analysis. • cite principles of data visualization. • identify well-established types of visualizations and their appropriate uses. • describe visualization best practices. • understand practical data visualization fundamentals in Python.

	• use different approaches for effective visual communication of data science results.
Careers/Graduate destinations	Entry to mid level.
Teaching and learning methods	Contact hours includes the following: (please click on the checkboxes as appropriate) ☒ Lectures ☐ Group Work: ☐ Seminars ☒ Tutorial ☐ Laboratory ☐ Workshops ☐ Practical ☒ VLE Activities
Indicative content	1. Exploratory Data Analysis 1.1 Location and variability 1.2 Further exploration of data distribution 1.3 Covariance and correlation 2. Data Visualization Principles 2.1 Coordinates and axes 2.2 Color spaces 2.3 Graph types 3. Data Visualization Practice 3.1 Amounts, proportions, associations, and distributions 3.2 Time series and trends 3.3 Geo-spatial data 4. Visualization in Python – Matplotlib and Seaborn 4.1 Introduction to PyPlot, Matplotlib, and Seaborn 4.2 Basic plots 4.3 Geo-spatial plots 5. Communicating Data Science 5.1 Unclutter, focus, and capture attention 5.2 Lessons from design 5.3 Principles of storytelling with data
Assessment method	Formative assessment: Summative assessment: Written Assignment (100%) At IU formative assessment is also informal and done within class. This practice of the summative assessment does not impact on the final summative assessment grade. This practice opportunity familiarises students with the assessment type and provides formative feedback that students can use for their final assessment. Formative assessment is also used as part of the process of supporting students reflect on their own learning. This course offers several practice exams.
Reading list	Required reading: See IU coursebook on Explorative Data Analysis and Visualization. Additional reading (optional): • Anderson, C. (2015). Creating a data-driven organization. Sebastopol, CA: O'Reilly Media.

	• Bruce, A., & Bruce, P. (2017). Practical statistics for data scientists. Sebastopol, CA: O'Reilly Media. • Grobmann, T., & Dobler, M. (2019). Data visualization with Python. Birmingham: Packt Publishing. • Nussbaumer Knaflic, C. (2015). Storytelling with data: A data visualization guide for business professionals. Chichester: John Wiley & Sons. • Wilke, C. O. (2019). Fundamentals of data visualization. Sebastopol, CA: O'Reilly Media.
Other Learning Resources	See MyCampus platform.

Course Descriptors
June 2022

Cloud Computing

COURSE DESCRIPTOR

Module name	Cloud Computing
Course name	Cloud Computing
Level	6
Course Code	DLBDSCC
Credit Value	10 UK Credits
Study-load	Contact hours: 30 Self-test: 30h Student managed learning hours: 90
Pre-requisites	None
Co-requisites	None
Dis-requisites	None
Course leader	Prof. Dr. Thomas Zöller
Module content outline	Many of the recent advances in data science, particularly machine learning and artificial intelligence, rely on comprehensive data storage and computing power. Cloud computing is one way of providing that power in a scalable way, without considerable upfront investment in hardware and software resources. This course introduces the area of cloud computing together with its enabling technologies. Moreover, the most cutting-edge advances like serverless computing and storage are illustrated. Finally, a thorough overview on popular cloud offerings, especially with regard to analytics capabilities, is given.
Course aims	This course introduces the area of cloud computing together with its enabling technologies.
Learning Outcomes	Having completed this module, students will be able to ▪ understand the fundamentals of cloud computing and cloud service models. ▪ recognize enabling technologies that underlie current cloud offerings. ▪ cite the principles of serverless computing. ▪ analyze characteristics of established cloud offerings. ▪ describe cloud options for data science and machine learning
Careers/Graduate destinations	Entry to mid level
Teaching and learning methods	Contact hours includes the following: (please click on the checkboxes as appropriate) ☒ Lectures ☐ Group Work: ☐ Seminars ☒ Tutorial

	☐ Laboratory ☐ Workshops ☐ Practical ☒ VLE Activities
Indicative content	1. Introduction to Cloud Computing 1.1 Fundamentals of cloud computing 1.2 Cloud service models 1.3 Benefits and risks 2. Enabling Technology 2.1 Virtualization and containerization 2.2 Storage technology 2.3 Networks and RESTful services 3. Serverless Computing 3.1 Introduction to serverless computing 3.2 Benefits 3.3 Limitations 4. Established Cloud Platforms 4.1 Google Cloud Platform 4.2 Amazon Web Services 4.3 Microsoft Azure 5. Data Science in the Cloud 5.1 Google data science and machine learning services 5.2 Amazon Web Services data science and machine learning services 5.3 Microsoft Azure data science and machine learning services
Assessment method	Formative assessment: Summative assessment: Exam (90min) At IU formative assessment is informal and done within class. This practice of the summative assessment does not impact on the final summative assessment grade. This practice opportunity familiarises students with the assessment type and provides formative feedback that students can use for their final assessment. Formative assessment is also used as part of the process of supporting students reflect on their own learning. This course offers several practice exams.
Reading list	Required reading: See IU coursebook on Cloud Computing Additional reading (optional): ▪ Chapin, J., & Roberts, M. (2017). What is serverless? Sebastopol, CA: O'Reilly Media. ▪ Goessling, S., & Jackson, K. L. (2018). Architecting cloud computing solutions. Birmingham: Packt Publishing. ▪ Kavis, M. J. (2014). Architecting the cloud: Design decisions for cloud computing service models (SaaS, PaaS, and

	IaaS). Hoboken, NJ: Wiley. ▪ Mahmood, Z., Puttini, R., & Erl, T. (2013). Cloud computing: Concepts, technology & architecture. Boston, MA: Prentice Hall. ▪ Rafaels, R. (2018). Cloud computing (2nd ed.). Scotts Valley, CA: CreateSpace Independent Publishing Platform. ▪ Sehgal, N. K., & Bhatt, P. C. P. (2018). Cloud computing: Concepts and practices. Cham: Springer. ▪ Zonooz, P. Farr, E., Arora, K., & Laszewski, T. (2018). Cloud native architectures. Birmingham: Packt Publishing. See IU coursebook on Cloud Computing
Other Learning Resources	See MyCampus platform.

Course Descriptors
June 2022

Seminar: Ethical Considerations in Data Science

COURSE DESCRIPTOR

Module name	Seminar: Ethical Considerations in Data Science
Course name	Seminar: Ethical Considerations in Data Science
Level	6
Course Code	DLBDSSECDS
Credit Value	10 UK Credits
Study-load	Contact hours: 30h Student managed learning hours: 120h
Pre-requisites	None
Co-requisites	None
Dis-requisites	None
Course leader	Prof. Dr. Claudia Hess
Module content outline	Online trade, social media, media delivery, mass consumption, customer relationship management, hiring decisions, and more: There are hardly any aspects of contemporary life that are not affected by the application of data science methodologies and techniques. Thus, it is of central importance to gain an awareness of these implications and a thorough understanding of the ethical issues in question in order to be an informed practitioner in this field.
Course aims	This seminar covers ethical implications of the use of data science methods and techniques. Each participant is expected to write a paper on an assigned topic.
Learning Outcomes	Having completed this module, students will be able to • contemplate ethical considerations in the field of data science. • describe how the application of data science methodology may have adverse ethical effects. reason about the ethical impacts of data science, both on a personal level and for society at large. • explain how existing biases and inequalities could be amplified by technology. • treat in a scientific manner a selected topic in the form of a written essay.
Careers/Graduate destinations	Entry to mid level positions
Teaching and learning methods	Contact hours includes the following: (please click on the checkboxes as appropriate) ☒ Lectures ☐ Group Work: ☐ Seminars ☒ Tutorial ☐ Laboratory ☐ Workshops

	☐ Practical ☒ VLE Activities
Indicative content	This seminar covers ethical implications of the use of data science methods and techniques. Each participant is expected to write a paper on an assigned topic.
Assessment method	Formative assessment: Summative assessment: Research Essay At IU formative assessment is also informal and done within class. This practice of the summative assessment does not impact on the final summative assessment grade. This practice opportunity familiarises students with the assessment type and provides formative feedback that students can use for their final assessment. Formative assessment is also used as part of the process of supporting students reflect on their own learning.
Reading list	Required reading: See IU coursebook on Seminar: Ethical Considerations in Data Science Additional reading (optional): • Association for Computing Machinery (ACM) (2018).ACM Code of Ethics and Professional Conduct. Retrieved from https://www.acm.org/code-of-ethics. • Baer, T. (2019). Understand, Manage, and Prevent Algorithmic Bias. A Guide for Business Users and Data Scientists. Apress. • Bloom, P. (2019). Monitored. Business and surveillance in a time of big data. Pluto Press; Knowledge Unlatched. • Garzcarek, U. & Steuer, D. (2019). Approaching Ethical Guidelines for Data Scientists. In Bauer,N., Ickstadt, K., Lübke, K.,Szepannek,G., Trautmann, H.&Vichi, M.(Eds.): Applications in statistical computing. From music data analysis to industrial quality improvement(pp.151–169). Springer. • O'Neil, C. (2017). Weapons of math destruction: How big data increases inequality and threatens democracy. Broadway Books. • Yarali, A., Joyce, R.& Dixon, B. (2020, April 22-24). Ethics of Big Data: Privacy, Security and Trust.2020 Wireless Telecommunications Symposium (WTS), Washington DC, United States. See IU coursebook on Seminar: Ethical Considerations in Data Science
Other Learning Resources	See MyCampus platform.

6th semester

Course Descriptors
June 2022

Time Series Analysis

COURSE DESCRIPTOR

Module name	Time Series Analysis
Course name	Time Series Analysis
Level	6
Course Code	DLBDSTSA
Credit Value	10 UK Credits
Study-load	Contact hours: 30h Self study: 30h Student managed learning hours: 90h
Pre-requisites	DLBDSSPDS01, DLBDSSIS01
Co-requisites	None
Dis-requisites	None
Course leader	Prof. Dr. Christian Müller-Kett
Module content outline	Many types of data describe patterns of events which occur sequentially and show dependencies on previous events, e.g., the number of guests in a hospitality service or the number of products sold in a retail outlet. These data show a particular temporal structure which can include additional effects such as seasonality or dependencies on external events. This course focuses on understanding time series data. After a general introduction to the elements of time series analysis, this course discusses ARMA-based models (Box-Jenkins approach) and the alternative Holt-Winters formalism, both of which are used for time series analysis and forecasting. This course also includes a discussion about advanced topics in time series analysis such as the handling of multiple seasonality's and framing a problem statement in the context of supervised learning.
Course aims	Students are familiarized with the following aspects: • Introduction to time series analysis • Time series components • Simple models • ARMA models • Holt-Winters models • Advanced topics
Learning Outcomes	Having completed this module, students will be able to • identify the fundamental concepts of time series analysis. cite the components of time series. • create simple time series models. • analyze time series data with ARMA and Holt-Winter models.

	• understand advanced topics in time series analysis.
Careers/Graduate destinations	Entry to mid level positions with administrative tasks.
Teaching and learning methods	Contact hours includes the following: (please click on the checkboxes as appropriate) ☒ Lectures ☐ Group Work: ☐ Seminars ☒ Tutorial ☐ Laboratory ☐ Workshops ☐ Practical ☒ VLE Activities
Indicative content	1. Introduction to Time-Series Analysis 1.1 What are time series? 1.2 Auto-correlation & partial auto-correlation 2. Time-Series Components 2.1 Trend 2.2 Seasonality 2.3 Residuals 3. Simple Models 3.1 Simple average 3.2 Moving average 3.3 Weighted moving average 4. ARMA Models 4.1 Box-Jenkins formalism 4.2 Handling non-stationary models: ARIMA 4.3 Seasonal ARIMA models: SARIMA 4.4 Seasonal models with external variables: SARIMAX 5. Holt-Winters Models 5.1 Simple exponential smoothing 5.2 Dealing with trends: double exponential smoothing 5.3 Dealing with seasonality: triple exponential smoothing 6. Advanced topics 6.1 Multiple seasonalities 6.2 Time series forecasting as a supervised learning problem
Assessment method	Formative assessment: Summative assessment: Exam (100% - 90min) At IU formative assessment is informal and done within class. This practice of the summative assessment does not impact on the final summative assessment grade. This practice opportunity familiarises students with the assessment type and provides formative feedback that students can use for their final assessment. Formative assessment is also used as part of the process of supporting students reflect on their own learning. This course offers several practice exams.
Reading list	Required reading: See IU coursebook on Statistics: Probability and Descriptive Statistics. Additional reading (optional):

	• Brockwell, P. J., & Davis, R. A. (2016). Introduction to time series and forecasting (3rd ed.). Springer. • Hyndman, R. J., & Athanasopoulos, G. (2021). Forecasting: Principles and practice (3rd ed.). OTexts. • Nielsen, A. (2019). Practical time series analysis: Prediction with statistics & machine learning.O'Reilly. • Shumway, R. H., & Stoffer, D. S. (2017). Time series analysis and its applications—With R examples(4th ed.). Springer.
Other Learning Resources	See MyCampus platform.

Course Descriptors
June 2022

Neural Nets and Deep Learning

COURSE DESCRIPTOR

Module name	Neural Nets and Deep Learning
Course name	Neural Nets and Deep Learning
Level	6
Course Code	DLBDSNNDL
Credit Value	10 UK Credits
Study-load	Contact hours: 20h Self study: 20h Student managed learning hours: 110h
Pre-requisites	None
Co-requisites	None
Dis-requisites	None
Course leader	TBD
Module content outline	Neural networks and deep learning approaches have revolutionized the fields of data science and artificial intelligence in recent years, and applications built on these techniques have reached or surpassed human performance in many specialized applications. After a short review of the origins of neural networks and deep learning, this course discusses in detail how feed-forward networks are set up and trained. Special focus is given on how to avoid overtraining in neural networks. In addition to feed-forward neural networks, this course covers additional common network architectures such as convolutional and recurrent neural networks. Moreover, by means of the accompanying video material and online tutorial support the impact of design choices and the data collection process on questions of algorithmic fairness both in terms of its individual as well as its societal dimension will be discussed.
Course aims	Students are familiarized with the following: • Introduction to neural networks • Feed-forward networks • Avoiding overtraining • Convolutional neural networks • Recurrent neural networks
Learning Outcomes	Having completed this module, students will be able to • understand the fundamental building blocks of neural networks. • identify different network training approaches. • create feed-forward neural networks.

	• analyze network training and how to avoid overtraining. • apply advanced network concepts to create convolutional and recurrent neural networks. • reason about the influence of model design and data selection on model outcomes in terms of social and personal equity.
Careers/Graduate destinations	Entry to mid level positions with administrative tasks.
Teaching and learning methods	Contact hours includes the following: (please click on the checkboxes as appropriate) ☒ Lectures ☐ Group Work: ☐ Seminars ☒ Tutorial ☐ Laboratory ☐ Workshops ☐ Practical ☒ VLE Activities
Indicative content	1. Introduction to Neural Networks 1.1 The biological brain 1.2 Building blocks of neural networks 1.3 Deep versus shallow networks 1.4 Supervised learning 1.5 Reinforcement learning 2. Feed-forward Networks 2.1 Architecture and weight initialization 2.2 Cost functions 2.3 Backpropagation and gradient descent 2.4 Batch normalization 3. Overtraining Avoidance 3.1 What is overtraining? 3.2 Early stopping 3.3 L1 and L2 regularization 3.4 Dropout 3.5 Weight pruning 4. Convolutional Neural Networks 4.1 Motivation and applications 4.2 Convolution and image filtering 4.3 CNN architecture 4.4 Popular convolutional networks 5. Recurrent Neural Networks 5.1 Recurrent neurons 5.2 Memory cells 5.3 LSTMs 5.4 Training RNNs: Unrolling through time
Assessment method	Formative assessment: Summative assessment: Oral Assignment At IU formative assessment is informal and done within class. This practice of the summative assessment does not impact on the final summative assessment grade. This practice opportunity familiarises students with the assessment type and provides formative feedback that students can use for their final assessment. Formative

	assessment is also used as part of the process of supporting students reflect on their own learning. This course offers several practice exams.
Reading list	Required reading: See IU coursebook on Statistics: Probability and Descriptive Statistics. Additional reading (optional): • Chollet, F. (2017). Deep learning with Python. Shelter Island, NY: Manning. • Efron, B., & Hastie, T. (2016). Computer age statistical inference. Cambridge: Cambridge University Press. • Gebru, T., and Woolery, E. (n.d.): Machine learning, bias, and product design. [Interview].Design Better. Retrieved from https://www.designbetter.co/conversations/timnit-gebru. • Geron, A. (2017). Hands-on machine learning with Scikit-Learn and TensorFlow. Sebastopol, CA: O'Reilly Publishing. • Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep learning. Boston, MA: MIT Press. • Grus, J. (2019). Data science from scratch: First principles with Python. Sebastopol, CA: O'Reilley Publishing.
Other Learning Resources	See MyCampus platform.

Course Descriptors
June 2022

Introduction to Data Protection and Cyber Security

COURSE DESCRIPTOR

Module name	Introduction to Data Protection and Cyber Security
Course name	Introduction to Data Protection and Cyber Security
Level	5
Course Code	DLBCSIDPITS
Credit Value	10 UK Credits
Study-load	Contact hours: 30h Self study: 30h Student managed learning hours: 90h
Pre-requisites	None
Co-requisites	None
Dis-requisites	None
Course leader	Prof. Dr. Ralf Kneuper
Module content outline	In this course, the students are familiarized with important concepts from the field of IT security. Basic terms are introduced and discussed, and typical application fields, areas of IT security application, and typical procedures and techniques are introduced and described.
Course aims	Students are familiarized with the following: • Fundamentals of IT • Security Data Protection • IT Security Management • Network and Communication Security
Learning Outcomes	Having completed this module, students will be able to • explain the terms and concepts of IT security and know the typical procedures and techniques which exist in each area. • cite the legal regulations on data protection and explain their implementation. • discuss in-depth IT security management and suitable measures for implementation. • use their overview knowledge of activities and strategies for IT security in software and system development.
Careers/Graduate destinations	Entry to mid level positions with administrative tasks.
Teaching and learning methods	Contact hours includes the following: (please click on the checkboxes as appropriate) ☒ Lectures ☐ Group Work: ☐ Seminars ☒ Tutorial ☐ Laboratory ☐ Workshops

	☐ Practical ☒ VLE Activities
Indicative content	1. Fundamentals of Data Protection and Cyber Security 1.1 Conceptual Bases, Protection Goals 1.2 Attacks and Threats 1.3 Security Strategy 1.4 Legal Regulations 2. Data Protection 2.1 Data Protection as a Personal Right 2.2 Basic Principles of Data Protection 2.3 EU General Data Protection Regulation 2.4 Further International Regulations on Data Protection 2.5 Cross-Border Data Flow 2.6 Data Protection in Everyday Life 3. Basic Functions of Cyber Security and Their Implementation 3.1 Identification and Authentication 3.2 Rights Management 3.3 Rights Check 3.4 Preservation of Evidence 4. Cyber Security Management 4.1 Basic Concepts and Standards in Cyber Security Management 4.2 Series of Standards ISO 2700x 5. Cyber Security Management in Everyday Life 5.1 Password Management 5.2 Data Backup 5.3 Email Security 5.4 Protection Against Viruses and Other Malware 5.5 Protection Against Social Engineering Attacks 6. Network and Communication Security 6.1 Firewall Technology 6.2 Network Separation 6.3 Security in WLAN, Mobile Networks, Bluetooth, and NFC 7. Cyber Security in the Development of Software and Systems 7.1 Protection of the Development Environment 7.2 Secure Development 7.3 Common Criteria
Assessment method	Formative assessment: Summative assessment: Exam (100% - 90min) At IU formative assessment is informal and done within class. This practice of the summative assessment does not impact on the final summative assessment grade. This practice opportunity familiarises students with the assessment type and provides formative feedback that students can use for their final assessment. Formative assessment is also used as part of the process of supporting students reflect on their own learning. This course offers several practice exams.

Reading list	Required reading: See IU coursebook on Statistics: Probability and Descriptive Statistics. Additional reading (optional): • Arnold, R. (2017). Cybersecurity: A business solution. An executive perspective on managing cyber risk. Threat Sketch. • Mattord, H., & Whitman, M. (2017). Management of information security. Cengage. • European Parliament and Council of the European Union. (2016). EU General Data Protection Regulation (GDPR): Regulation 2016/679 of the European Parliament and of the council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation). Official Journal of the European Union. Chapters 1—3
Other Learning Resources	See MyCampus platform.

Course Descriptors
June 2022

Model Engineering

COURSE DESCRIPTOR

Module name	Model Engineering
Course name	Model Engineering
Level	6
Course Code	DLBDSME
Credit Value	10 UK Credits
Study-load	Contact hours: 20h Self study: 20h Student managed learning hours: 110h
Pre-requisites	None
Co-requisites	None
Dis-requisites	None
Course leader	TBD
Module content outline	Building high-quality predictive models is one of the core competencies of data scientists. This course begins with an introduction to relevant data science approaches such as CRISP-DM and Microsoft Team Data Science. The following section on model building focuses on the best practices that allow data scientists to build enterprise-grade models. Subsequent chapters explore techniques for model validation and model combination, also known as ensemble learning. Traditionally, the most explainable models have not been very powerful, and the most powerful models have not been very explainable. Nevertheless, interpretable models—and interpretable machine learning models in particular—are highly desirable in many areas. This course gives a detailed overview of common approaches, such as surrogate model visualizations, which illustrate the behavior of the models.
Course aims	Students are familiarized with the following: • Data science methodologies • Model building • Model evaluation • Model combination • Interpretable models
Learning Outcomes	Having completed this module, students will be able to • understand common data science methodologies. create benchmark models. • analyze models with respect to their interpretability. • apply model validation techniques. • recall established model combination techniques.

Careers/Graduate destinations	Entry to mid level positions with administrative tasks.
Teaching and learning methods	Contact hours includes the following: (please click on the checkboxes as appropriate) ☒ Lectures ☐ Group Work: ☐ Seminars ☒ Tutorial ☐ Laboratory ☐ Workshops ☐ Practical ☒ VLE Activities
Indicative content	1. Data Science Methodologies 1.1 CRISP-DM 1.2 MS Team Data Science 2. Model Building 2.1 Establishing a benchmark model 2.2 Workflow automation 2.3 Model persistence and model versioning 3. Model Evaluation 3.1 Under- and overfitting 3.2 Cross validation 4. Interpretable models 4.1 Why interpretable models? 4.2 Black-box versus interpretable models 4.3 Visualizers for convolutional neural networks 4.4 Surrogate models 5. Combining Learning Models 5.1 Bagging 5.2 Boosting 5.3 Model stacking2.4 Important continuous probability distributions
Assessment method	Formative assessment: Summative assessment: Case Study At IU formative assessment is informal and done within class. This practice of the summative assessment does not impact on the final summative assessment grade. This practice opportunity familiarises students with the assessment type and provides formative feedback that students can use for their final assessment. Formative assessment is also used as part of the process of supporting students reflect on their own learning. This course offers several practice exams.
Reading list	Required reading: See IU coursebook on Statistics: Probability and Descriptive Statistics. Additional reading (optional): • Chapman, P. (n.d.). CRISP-DM user guide [PDF document]. Retrieved from https://s2.smu.edu/ ~mhd/8331f03/crisp.pdf ▪ Geron, A. (2017). Hands-on machine learning with Scikit-Learn and TensorFlow. Sebastopol, CA: O'Reilly.

	• Kuhn, M., & Johnson, K. (2013). Applied predictive modelling. New York, NY: Springer. • Maydanchik, A. (2007). Data quality assessment. Denville, NJ: Technics Publications. • Microsoft. (2017). Team Data Science process documentation [training course]. Retrieved from https://docs.microsoft.com/en-us/azure/machine-learning/team-data-science-process/ overview • Molnar, C. (2019). Interpretable machine learning: A guide for making black box models explainable. Retrieved from https://christophm.github.io/interpretable-ml-book/ • Müller, A., & Guido, S. (2016). Introduction to machine learning with Python: A guide for data scientists. Sebastopol, CA: O'Reilly. • Zheng, A. (2015). Evaluating machine learning models. Sebastopol, CA: O'Reilly.
Other Learning Resources	See MyCampus platform.

Course Descriptors
June 2022

Bachelor Thesis & Colloquium

COURSE DESCRIPTOR

Module name	Bachelor Thesis
Course name	Bachelor Thesis & Colloquium
Level	6
Course Code	DLBBT - Bachelor Thesis (DLBBT01) - Colloquium (DLBBT02)
Credit Value	30 UK Credits - Bachelor Thesis (27 UK Credits) - Colloquium (3 UK Credits)
Study-load	Bachelor Thesis: Contact hours: 0h Self study: 0h Student managed learning hours: 270h Colloquium: Contact hours: 0h Self study: 0h Student managed learning hours: 30h
Pre-requisites	
Co-requisites	None
Dis-requisites	None
Course leader	TBD
Module content outline	Bachelor Thesis: The aim and purpose of the bachelor's thesis is to successfully apply the subject-specific and methodological competencies acquired during the course of study in the form of an academic dissertation with a thematic reference to the major field of study. The content of the bachelor's thesis can be a practical-empirical or theoretical-scientific problem. Students should prove that they can independently analyze a selected problem with scientific methods, critically evaluate it, and work out proposed solutions under the subject-methodological guidance of an academic supervisor. The topic chosen by the student from their respective field of study should meet the acquired scientific competences, deepening their academic knowledge and skills in order to meet the future needs of the field. Colloquium: The colloquium will take place after the submission of the bachelor's thesis. This is done at the invitation of the experts. During the colloquium, students must prove that they have independently produced the content and results of the written work. The content of the colloquium is a presentation of the most important work contents

	and research results by the student as well as the answering of questions by experts.
Course aims	Bachelor Thesis: • The bachelor's thesis must be written on a topic that relates to the content of the respective major field of study. In the context of the bachelor's thesis, the problem, as well as the scientific research goal, must be clearly emphasized. The work must reflect the current state of knowledge of the topic to be examined by means of an appropriate literature analysis. The student must prove their ability to use the acquired knowledge theoretically and/or empirically in the form of an independent and problem-solution-oriented application. Colloquium: • The colloquium will take place after the submission of the bachelor's thesis. This is done at the invitation of the experts. During the colloquium, students must prove that they have independently produced the content and results of the written work. The content of the colloquium is a presentation of the most important work contents and research results by the student as well as the answering of questions by experts. •
Learning Outcomes	Bachelor Thesis: Having completed this module, students will be able to • work on a problem from their major field of study by applying the specialist and methodological skills they have acquired during their studies. • independently analyze selected tasks with scientific methods, critically evaluate them, and develop appropriate solutions under the guidance of an academic supervisor. • record and analyze existing (research) literature appropriate to the topic of their bachelor's thesis. • prepare a detailed written elaboration in compliance with scientific methods. Colloquium: Having completed this module, students will be able to • present a problem from their field of study using academic presentation and communication techniques. • reflect on the scientific and methodological approach chosen in their bachelor's thesis. • demonstrate that they can actively answer subject-related questions from the subject experts (reviewers of the bachelor's thesis).
Careers/Graduate destinations	Entry to mid level positions with administrative tasks.
Teaching and learning methods	Contact hours includes the following: (please click on the checkboxes as appropriate)

	☐ Lectures ☐ Group Work: ☐ Seminars ☐ Tutorial ☐ Laboratory ☐ Workshops ☐ Practical ☒ VLE Activities
Assessment method	Formative assessment: Summative assessment: Thesis (90%) + Defence (10%)
Reading list	Required reading: See coursebook. Additional reading (optional): • Turabian, K. L. (2013). A Manual for Writers of Research Papers, theses, and dissertations (8th ed.). University of Chicago Press. • Lipson, C. (2018). How to write a BA thesis. A practical guide from your first ideas to your finished paper (2nd ed.). University of Chicago Press. • Selection of literature according to topic
Other Learning Resources	See MyCampus platform.