Module Manual

Certified Financial Engineer

Content

Qualification goals

The aim of the "Certified Financial Engineer" certificate program is to prepare participants optimally to solve specialist tasks using data analytics skills and to prepare and make decisions in the financial sector at an international level. Furthermore, the "Certified Financial Engineer" certificate program is intended to create the conditions for graduates to enrich their academic careers with special knowledge in the field of financial engineering.

Absolventen des Zertifikatsprogramms „Certified Financial Engineer“ sind in der Lage:

1. to recognize structures and processes of financial decisions from the point of view of financial engineering in their complexity, to evaluate them appropriately and to adapt them to changes in the markets or to evaluate decisions strategically.
2. to analyse complex problems in the field of financial engineering in an interdisciplinary manner, to identify possible adjustment screws, to optimise them in a targeted manner and, if necessary, to develop solutions independently.
3. to use quantitative methods for the solution of concrete problems and as decision support.
4. to critically reflect on their own patterns of action and to adapt to changing conditions with creativity and flexibility and to deal constructively with opportunities and risks.
5. selbständig wissenschaftlich zu arbeiten und als nächsten Schritt ihrer akademischen Laufbahn das Thema "Quantitative Finance" bei qualifiziertem Abschluss in einem Bachelor- oder Masterprogramm sowie ggf. in einem Promotionsstudium zu vertiefen.

In order to become a "Certified Financial Engineer", a case study has to be completed as part of the Professional Excellence pathway and a case study as part of the Academic Excellence pathway, as well as either an oral or a written examination from the following subject areas:

1. Financial Engineering with Derivatives
2. Financial Engineering in Risk Management
3. Financial Engineering in Corporate Finance

Module		1. Financial Engineering with Derivatives
Contribution of the module to the study objectives	Qualification goals	• know and analyse different products in the field of options and futures • present the options and futures relevant in practice. • price options independently and critically evaluate the premises of the underlying models. • recognise and critically question the differences between the Black-Scholes model and the Cox-Ross-Rubinstein model. • know the advantages and disadvantages of the different pricing approaches. • analyse and evaluate different option strategies based on real stock performance. • use various Excel functions in a targeted manner when implementing different option strategies. • apply the standards of financial modeling when creating option and futures pricing models. • transfer the knowledge and skills of financial engineering with options and futures to other tasks and thus combine different fields of finance. • evaluate results and conclusions in professional and interactive overview charts for presentation.
	Content	• see Courses
	Teaching / Learning methods	• Case study, literature study, Excel-based exercises and exploratory learning
Exam		• Study work in the form of case studies (80%) / oral examination or Klausur (20%)
Organisation	Lecturers	• Prof. Dr. Dr. Dietmar Ernst • Prof. Dr. Dr. Joachim Häcker
	ECTS	• 8 ECTS
	Workload	• 200 hours
	Type of studies	• Self-study: 100%
Courses		• Basis of options and futures • Option strategies

<table>
<tr><td colspan="2">Course</td><td colspan="4">3.1 Basis of options and futures</td></tr>
<tr><td rowspan="7">Design</td><td rowspan="5">Qualification goals</td><td colspan="4">The students should be enabled to
• to know and analyse the different products in the field of options and futures
• to present the options and futures relevant in practice.
• to price options independently and critically evaluate the premises of the underlying models.
• to recognise and critically question the differences between the Black-Scholes model and the Cox-Ross-Rubinstein model.
• to understand the extension of the Black-Scholes model to the Black-Scholes-Merton model and to recognize the implications for business practice.
• to know the advantages and disadvantages of the different pricing approaches.
• to apply the standards of financial modeling when creating option and futures pricing models.
• to transfer knowledge and skills of financial engineering with options and futures to other tasks and thereby combine different fields of finance.
• to holistically evaluate the results and conclusions of different pricing options in professional and interactive overview charts for presentation.</td></tr>
<tr><td>Knowledge</td><td>Understanding</td><td>Abilities</td><td>Competences</td></tr>
<tr><td>Subject</td><td>X</td><td>x</td><td>x</td></tr>
<tr><td>System</td><td>X</td><td>x</td><td></td></tr>
<tr><td>Self</td><td>X</td><td>x</td><td>x</td></tr>
<tr><td>Social</td><td>X</td><td></td><td></td></tr>
<tr><td>Content</td><td colspan="4">• Functionality of options
• Value drivers of options
• Analysis of intrinsic value and fair value
• Pricing of options with the binomial model
• Pricing of options with the Black-Scholes model
• Pricing of options using the Black-Scholes-Merton model
• Analysis of options with the Greeks
• Pricing of index futures
• Pricing of interest rate futures
• Pricing of currency futures
• Pricing of Commodity Futures
• Pricing of futures on single stocks</td></tr>
<tr><td>Teaching / Learning methods</td><td colspan="4">Case study, literature study, Excel-based exercises and exploratory learning</td></tr>
<tr><td>Literature / teaching material</td><td colspan="4">In addition to the course book and the standard literature, further special literature will be issued within the framework of the cases.
Course book:
• Häcker, J., Ernst D. (2017, editors): Financial Modeling – An Introductory Guide to Excel and VBA Applications in Finance, London (UK).
• Ernst, D., Häcker, J. (2016, Hrsg.): Financial Modeling, 2. Auflage, Stuttgart.
Standard literature:
• Hull, J.C. (2018): Options, Futures, and Other Derivatives, 9. Auflage, London.</td></tr>
<tr><td>Special features of the course</td><td colspan="4">The processing of the case study is closely monitored by the professors. Feedback is given to the participants through regular learning controls.</td></tr>
<tr><td rowspan="3">Organisation</td><td>ECTS</td><td colspan="4">8 ECTS</td></tr>
<tr><td>Workload</td><td colspan="4">200 hours</td></tr>
<tr><td>Type of studies</td><td colspan="4">Self-study: 100%</td></tr>
</table>

<table>
<tr><td colspan="2">Course</td><td colspan="4">3.2 Option strategies</td></tr>
<tr><td rowspan="6">Design</td><td>Qualification goals</td><td colspan="4">The students should be enabled to
• to present the option strategies relevant in practice.
• to recognize the differences between the individual option strategies and to critically question them.
• to know the advantages and disadvantages of the different option strategies.
• to analyse and evaluate the different option strategies on the basis of real stock performance.
• to use different excel-functions in a target-oriented way when implementing different option strategies.
• apply the standards of financial modeling when determining an option strategy.
• to transfer the knowledge and skills of financial engineering with options and futures to other tasks and thereby combine different fields of finance.
• - to evaluate the results of the various option strategies and conclusions in professional and interactive overview charts in Excel within the framework of a presentation.</td></tr>
<tr><td colspan="2"><table>
<tr><th>Knowledge</th><th>Understanding</th><th>Abilities</th><th>Competences</th></tr>
<tr><td>Subject</td><td>x</td><td>x</td><td>x</td></tr>
<tr><td>System</td><td>x</td><td>x</td><td></td></tr>
<tr><td>Self</td><td>x</td><td>x</td><td>x</td></tr>
<tr><td>Social</td><td>x</td><td></td><td></td></tr>
</table></td></tr>
<tr><td>Content</td><td colspan="4">• Basic strategies (long-call, short-call, long-put, short-put)
• Bullish option strategies (covered calls OTM, covered calls ITM, call backspread, bull call spread, bull put spread, protective put, collar strategy)
• Bearish option strategies (covered put, put backspread, bear put spread, bear call spread, protective call)
• Neutral strategies – bearish volatility strategies (condor options, long call butterfly, long put butterfly, long call ladder, long put ladder, short strangle, short straddle, short guts)
• Neutral strategies – bullish volatility strategies (short condor, short call butterfly, short put butterfly, short call ladder, short put ladder, long strangle, long straddle, strip, strap, long guts)
• Connection of the option strategies
• Procedure for determining an option strategy</td></tr>
<tr><td>Teaching / Learning methods</td><td colspan="4">Case study, literature study, Excel-based exercises and exploratory learning</td></tr>
<tr><td>Literature / teaching material</td><td colspan="4">In addition to the course book and the standard literature, further special literature will be issued within the framework of the cases.
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<tr><td rowspan="2">Organisation</td><td>ECTS</td><td colspan="4">8 ECTS</td></tr>
<tr><td>Workload</td><td colspan="4">200 hours</td></tr>
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	Type of studies	Self-study: 100%

Module		2. Financial Engineering im Risk Management
Contribution of the module to the study objectives	Qualification goals	• present the risk management instruments relevant in practice. • independently perform risk analyses and critically evaluate the premises of the underlying models. • know and analyse different distribution functions. • critically question the concept of normal distribution. • know the advantages and disadvantages of vale at risk and make and evaluate a choice between the approaches. • know the significance of extreme risks (fat tails) and apply models to take extreme risks into account. • evaluate risks at portfolio level and critically discuss different models. • aggregate and analyze risks in a portfolio using Monte Carlo simulation. • apply the standards of financial modeling when creating risk models. • use Excel functions and other software tools to perform risk analyses in a targeted manner. • transfer the knowledge and skills of risk management to other tasks and thus combine different fields of finance • evaluate results and conclusions in professional presentations.
	Content	• see Courses
	Teaching / Learning methods	• Case study, literature study, Excel-based exercises and exploratory learning
Exam		• Study work in the form of case studies (80%) / oral examination or Klausur (20%)
Organisation	Lecturers	• Prof. Dr. Dr. Dietmar Ernst • Prof. Dr. Dr. Joachim Häcker
	ECTS	• 8 ECTS
	Workload	• 200 hours
	Type of studies	• Self-study: 100%
Courses		• Risikoanalyse • Quantitative Instrumente im Risk Management

<table>
<tr><td colspan="2">Course</td><td>2.1 Risk Analysis</td></tr>
<tr><td rowspan="4">Design</td><td>Qualification goals</td><td>The students should be enabled to
to calculate different types of return, to critically assess their conception and to decide which types of return are used for which risk analysis objectives.
to analyse statistical methods in a well-founded way and to use them for risk analysis in a purposeful way.
to evaluate empirical data with the help of probability theory models for risk analysis and to draw conclusions about their distribution.
perform risk analysis using financial modeling tools and provide an objective assessment of how risk management issues can be solved using financial modeling.
to discuss the different approaches to calculating variance and standard deviation, to calculate risk measures for different periods of time and to select suitable methods.
to carry out volatility calculations, initially with simple and then increasingly complex models, and to critically discuss the advantages and disadvantages of these approaches.
to obtain and process the necessary data for risk management from information providers such as Bloomberg or Thomson Reuters.
to structure a problem in risk calculation using financial modeling techniques, assigning different Excel functions and other software tools.
to master the theoretical and empirical challenges of risk calculations.
to critically question the assumptions, algorithms and results of each model.
to prepare the results of the return and risk calculations in professional presentations.
<table>
<tr><th>Knowledge</th><th>Understanding</th><th>Abilities</th><th>Competences</th></tr>
<tr><td>Subject</td><td>x</td><td>x</td><td>x</td></tr>
<tr><td>System</td><td>x</td><td>x</td><td></td></tr>
<tr><td>Self</td><td>x</td><td>x</td><td>x</td></tr>
<tr><td>Social</td><td>x</td><td></td><td></td></tr>
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<tr><td>Content</td><td>Calculation of returns as a basis for risk analysis
Creation of a histogram, a density function and a distribution function
Calculation of the skewness and curvature
Calculation of annualised and sub-periodic standard deviation and variance
Calculation of the semivariance and the semi-standard deviation
Calculation of the moving volatility
Calculation of the sliding volatility with linearly decreasing weights and with exponentially decreasing weights
Calculation of volatility with the EWMA model
Calculation of volatility with the ARCH model
Calculation of volatility with the GARCH model</td></tr>
<tr><td>Teaching / Learning methods</td><td>Case study, literature study, Excel-based exercises and exploratory learning</td></tr>
<tr><td>Literature / teaching material</td><td>In addition to the course book and the standard literature, further special literature will be issued within the framework of the cases.
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Ernst, D., Häcker, J. (2016, Hrsg.): Financial Modeling, 2. Auflage, Stuttgart.
Standard literature:
Hopkin, P. (2018): Fundamentals of Risk Management: Understanding, Evaluating and Implementing Effective Risk, 5. Auflage, New York.
Hull, J.C. (2018): Risk Management and Financial Institutions, 5. Auflage, Hoboken (New Jersey).</td></tr>
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	Special features of the course	The processing of the case study is closely monitored by the professors. Feedback is given to the participants through regular learning controls.
Organisation	ECTS	8 ECTS
	Workload	200 ours
	Type of studies	Self-study: 100%

<table>
<tr><td colspan="2">Course</td><td colspan="4">2.2 Quantitative Instrumente im Risk Management</td></tr>
<tr><td rowspan="4">Design</td><td rowspan="2">Qualification goals</td><td colspan="4">The students should be enabled to
to structure a problem in risk management using financial modeling techniques, assigning different Excel functions and other software tools
to critically discuss different types of Value at Risk (Absolute Value at Risk, Relative Value at Risk and Conditional Value at Risk (Expected Shortfall)) and to consider their advantages and disadvantages when making decisions
to calculate different types of value at risk for discrete and continuous returns and to evaluate their statements.
to apply the value at risk concept to non-linear price functions (e.g. bond prices) and to use risk indicators such as duration, modified duration and convexity and to critically discuss their statements.
To use lower partial moments as further risk measures and to distinguish them from the value at risk approach.
To use extreme value theory to assess extreme risks.
To critically discuss the concepts of Value at Risk, Lower Partial Moments and Extreme Value Theory and make decisions about their possible applications.
To apply value at risk concepts to portfolios.
To apply the variance-covariance method for a portfolio and to assess its limits.
to perform a historical simulation and make risk statements.
independently perform a Monte Carlo simulation for aggregation and further process the results in a risk analysis.
To perform a Monte Carlo simulation with calibration and copula functions and to discuss the approaches and results critically.
Incorporate non-hedgeable risks into a business plan, aggregate them and apply different risk measures.
to prepare the results of the quantitative risk analysis in professional presentations.</td></tr>
<tr><td colspan="4"><table>
<tr><th>Knowledge</th><th>Understanding</th><th>Abilities</th><th>Competences</th></tr>
<tr><td>Subject</td><td>x</td><td>x</td><td>x</td></tr>
<tr><td>System</td><td>x</td><td>x</td><td></td></tr>
<tr><td>Self</td><td>x</td><td>x</td><td>x</td></tr>
<tr><td>Social</td><td>x</td><td></td><td></td></tr>
</table></td></tr>
<tr><td>Content</td><td colspan="4">Calculation of the value at risk of the relative value at risk and the for a discrete probability distribution
Calculation of the value at risk of the relative value at risk and the conditional value at risk (expected shortfall) for a continuous probability distribution
Value at risk for non-linear price functions: bonds
Calculation of lower partial moments: shortfall probability, shortfall expected value and shortfall variance
Extreme value theory
Determination in portfolio risks
Variance-covariance method for calculating portfolio risk, value at risk and conditional value at risk
Historical simulation
Monte Carlo simulation: normally distributed risk parameters and calibrated risk parameters
Monte Carlo simulation based on Copula functions
Modelling of non-hedgeable risks in a business plan</td></tr>
<tr><td>Teaching / Learning methods</td><td colspan="4">Case study, literature study, Excel-based exercises and exploratory learning</td></tr>
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	Literature / teaching material	In addition to the course book and the standard literature, further special literature will be issued within the framework of the cases. Course book: • Häcker, J., Ernst D. (2017, editors): Financial Modeling – An Introductory Guide to Excel and VBA Applications in Finance, London (UK). • Ernst, D., Häcker, J. (2016, Hrsg.): Financial Modeling, 2. Auflage, Stuttgart. Standard literature: • Hopkin, P. (2018): Fundamentals of Risk Management: Understanding, Evaluating and Implementing Effective Risk, 5. Auflage, New York. • Hull, J.C. (2018): Risk Management and Financial Institutions, 5. Auflage, Hoboken (New Jersey).
	Special features of the course	The processing of the case study is closely monitored by the professors. Feedback is given to the participants through regular learning controls.
Organisation	ECTS	8 ECTS
	Workload	200 hours
	Type of studies	Self-study: 100%

Module		3. Financial Engineering in Corporate Finance
Contribution of the module to the study objectives	Qualification goals	• know the business valuation metrics used by valuation professionals and apply them with confidence. • compare and present the value and price of a company and assign it to the valuation and pricing methods of corporate finance. • know and critically discuss the differences between the world of perfect capital markets. • apply methods and models of risk analysis in business valuation and adapt them to given issues. • apply the standards of financial modelling when creating financial models in corporate finance. • structure a valuation problem using financial modeling tools, convert the structure into a financial model and use it to solve a given problem. • master business valuation models for perfect capital markets in such a way that the DCF approaches deliver identical enterprise values. • model imperfect capital markets in accordance with the standards of financial modeling in order to provide decision support. • make targeted use of Excel functions and Monte Carlo simulation models to solve valuation problems. • transfer knowledge and skills in business valuation to other tasks and thus combine different fields of finance. • evaluate results and conclusions in professional presentations.
	Content	• see Courses
	Teaching / Learning methods	• Case study, literature study, Excel-based exercises and exploratory learning
Exam		• Study work in the form of case studies (80%) / oral examination or Klausur (20%)
Organisation	Lecturers	• Prof. Dr. Dr. Dietmar Ernst • Prof. Dr. Dr. Joachim Häcker
	ECTS	8 ECTS
	Workload	200 hours
	Type of studies	Self-study: 100%
Courses		• Professional Company Valuations on Perfect Capital Markets • Professional Company Valuations on Imperfect Capital Markets

<table>
<tr><th colspan="2">Course</th><th colspan="4">3.1 Professional Company Valuations on Perfect Capital Markets</th></tr>
<tr><td rowspan="7">Design</td><td>Qualification goals</td><td colspan="4">The students should be enabled to
to differentiate all DCF approaches and to draw conclusions as to which differences lead to different company values.
Model all DCF approaches in such a way that identical enterprise values result.
Model all DCF approaches for the world of safe and uncertain tax shields.
independently structure complex business valuation tasks and develop independent models for their solutions.
to evaluate the results of DCF company valuations and independently draw conclusions for corporate finance transactions.
to review the structure of the valuation model and the results of the company valuation by means of model review.
to manage a project in the field of company valuation and to develop own solutions in a group of valuation specialists.
to master theoretical and empirical challenges of DCF company valuation.
apply their knowledge to given valuation projects and adapt it to real valuation situations.
to critically question the assumptions, algorithms and results of each valuation approach.
to prepare the results of the DCF company valuation in professional presentations.</td></tr>
<tr><td colspan="2"><table>
<tr><th>Knowledge</th><th>Understanding</th><th>Abilities</th><th>Competences</th></tr>
<tr><td>Subject</td><td>x</td><td>x</td><td>x</td></tr>
<tr><td>System</td><td>x</td><td>x</td><td></td></tr>
<tr><td>Self</td><td>x</td><td>x</td><td>x</td></tr>
<tr><td>Social</td><td>x</td><td></td><td></td></tr>
</table></td></tr>
<tr><td>Content</td><td colspan="4">Unterschiede zwischen den DCF-Ansätzen und notwendige Modellanpassungen
Die Welt sicherer und unsicherer Tax Shields
Periodenspezifischer WACC-Ansatz
Total Cashflow Ansatz
APV-Ansatz
Periodenspezifischer Equity-Ansatz
Schlussfolgerungen</td></tr>
<tr><td>Teaching / Learning methods</td><td colspan="4">Case study, literature study, Excel-based exercises and exploratory learning</td></tr>
<tr><td>Literature / teaching material</td><td colspan="4">In addition to the course book and the standard literature, further special literature will be issued within the framework of the cases.
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Ernst, D., Häcker, J. (2016, Hrsg.): Financial Modeling, 2. Auflage, Stuttgart.
Standard literature:
Koller, T., Goedhardt, M., Wessels, D. (2020): Valuation: Measuring and Managing the Value of Companies, Hoboken (New Jersey).</td></tr>
<tr><td>Special features of the course</td><td colspan="4">The processing of the case study is closely monitored by the professors. Feedback is given to the participants through regular learning controls.</td></tr>
<tr><td></td><td>ECTS</td><td colspan="4">8 ECTS</td></tr>
</table>

Organisa-tion	Workload	200 hours	
	Type of studies	self-study: 100%	
Course		3.2 Professional Company Valuations on Imperfect Capital Markets	
Design	Qualification goals	The students should be enabled to • to critically question the assumptions of perfect capital markets and draw conclusions for a realistic company valuation. • to develop a catalogue of requirements for company valuation models in imperfect capital markets. • to integrate risks that are not covered by the company into the business plan of a company. • Define probability distributions for non-hedged risks. • Integrate approaches for considering insolvency risks in the business plan. • Aggregate the risks defined in the business plan using Monte Carlo simulation. • analyze and evaluate the overall risks at the cash flow level. • derive capital costs from the risk analysis of cash flows. • to incorporate the identified risks into DCF company valuation models and to professionally value companies in imperfect capital markets. • to evaluate the results of company valuations in imperfect capital markets, to compare these with the results of DCF company valuations in perfect capital markets and to independently draw conclusions for corporate finance transactions. • to manage a project in the field of business valuation and to develop own solutions in a group of valuation specialists. • to master theoretical and empirical challenges of DCF company valuation on imperfect capital markets. • to apply their knowledge to given valuation projects and adapt it to real valuation situations. • to critically question the assumptions, algorithms and results of each valuation approach. • to prepare the results of the DCF company valuation on imperfect capital markets in professional presentations.	The students should be enabled to critically question the a

			s s u m p ti o n s o f p e r f e c t c a p it a l m a r k e t s a n d d r a w c o n c l u s i o n s f o r a r e

			alistic company valuation. - to develop a catalogue of requirements

			for company valuation models in imperfect capital markets. - to int

			egrateriskstthatarenotcoveredbythecompanyintothebusiness

			plan of a company. - Define probability distributions for non-hedge

			drisks.-Integrateapproachesforconsideringinsolvencyrisk

			sinthebusinessplan.-Aggregatetherisksdefinedinthebusinine

			s s p l a n u s i n g M o n t e C a r l o s i m u l a t i o n . - a n a l y z e a n d e v a l u a t e t h e o v

			eralliskssatthecashflowlevel.-derivecapitalcostsfromtheris

			kanalysisofcashflows.-toincorporatetheidentifiedrisksint

			oDCFcompanyvaluationmodelsandtoprofessionallyvaluecompani

			esinimperfectcapitalmarkets.-toevaluatetheresultsofcompan

			yvaluationsinimperfectcapitalmarkets,tocomparethesewiththe

			results of DCF company valuations in perfect capital markets and to i

			ndependentlydrawconclusionsforcorporatefinancetransaction

			s.-tomanageaprojectinthefieldofbusinessvaluationandtodev

			elopownsolutionsinagroupofvaluationspecialists.-tomasterth

			eoreticalandempiricalchallengesofDCFcompanyvaluationonimpe

			rfectcapitalmarkets.-toapplytheirknowledgetogivenvaluatio

			n p r o j e c t s a n d a d a p t it t o r e a l v a l u a ti o n s it u a ti o n s . - t o c r it i c a ll y q u e

			stionthe assumptions, algorithms and results of each valuation appro

			a c h . - t o p r e p a r e t h e r e s u lt s o f t h e D C F c o m p a n y v a l u a ti o n o n i m p e r f e

						ctcapitalmarketsinprofessionalpresentations.
		Knowledge	Understanding	Abilities	Competences	
		Subject	x	x	x	
		System	x	x		
		Self	x	x	x	
		Social	x			
	Content	• - The world of imperfect capital markets • - Non-hedgeable risks in the business plan • - Consideration of insolvency risks • - Risk aggregation with Monte Carlo simulation • - Risk analysis of cash flows				

		• - Cost of equity taking into account the risk analysis of cash flows • - DCF valuation on imperfect capital markets • - Comparison of the DCF valuation on perfect and imperfect capital markets
	Teaching / Learning methods	Case study, literature study, Excel-based exercises and exploratory learning
	Literature / teaching material	In addition to the course book and the standard literature, further special literature will be issued within the framework of the cases. Course book: • Häcker, J., Ernst D. (2017, editors): Financial Modeling – An Introductory Guide to Excel and VBA Applications in Finance, London (UK). • Ernst, D., Häcker, J. (2016, Hrsg.): Financial Modeling, 2. Auflage, Stuttgart. Standard literature: • Koller, T., Goedhardt, M., Wessels, D. (2020): Valuation: Measuring and Managing the Value of Companies, Hoboken (New Jersey).
	Special features of the course	The processing of the case study is closely monitored by the professors. Feedback is given to the participants through regular learning controls.
Organisation	ECTS	8 ECTS
	Workload	200 hours
	Type of studies	Self-study: 100%