Module manual

of the M. Sc. degree programme in

Mathematical Finance

Christian-Albrechts-Universität zu Kiel
Mathematisch-Naturwissenschaftliche Fakultät

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A. Overview of the Degree Programme M.Sc. Mathematical Finance

1. Programme Schedule

1st Sem	**Mathematical Finance**		**Advanced Mathematics**	**Financial Economics**	**Econo-metrics/ Statistics**	
2nd Sem	**Computational Finance**		**Mathematical Finance and Stochastic Integration**	**Financial Economics**	**Internship**	**Semi-nar**
3rd Sem	**Advanced Math. Finance**	**Advanced Math. Finance**	**Advanced Mathematics**	**Financial Economics**	**Econo-metrics/ Statistics**	**Semi-nar**
4th Sem	**Master Thesis**					**Research Seminar**

2. Structure of Curriculum

Section	Module	Type of examination	SWS	CP Module	CP Section
Compulsory Section in Mathematical Finance	Mathematical Finance	O or W	4L +2T	9	27
	Computational Finance	O or W	4L + 2T	9	
	Mathematical Finance and Stochastic Integration	O or W	4L + 2T	9	
Advanced Mathematical Finance	Module I	O or W	2L + 1T	5	10
	Module II	O or W	2L + 1T	5	
Advanced Mathematics	Module I (Mathematics)	O or W	4L + 2T	9	18
	Module II (Applied Mathematics)	O or W	4L + 2T	9	
Financial Economics	Financial Economics I	W	2L + 1T	5	15
	Financial Economics II	W	2L + 1T	5	
	Financial Economics III	W	2L + 1T	5	
Econometrics and Statistics	Econometrics I / Advanced Statistics II	O or W	2L + 1T	5	9
	Econometrics for Financial Markets/ Statistics for Financial Markets/ Multivariate Time Series Analysis and Forecasting/ Univariate Time Series Analysis	O or W	2L + 1T	4	
Seminars	Seminar I	P	2	4	11
	Seminar II (Mathematical Finance)	P	2	4	
	Research Seminar on Master Thesis	P	2	3	
Internship		R	Not specified	4	4
Master Thesis					26
$\sum$					120

Explanations:
W: written examination, O: oral examination, P: presentation, R: Report
SWS: "Semesterwochenstunden" = weekly 45-minute teaching hours during the semester.
Types: L = lecture, T = tutorial, S = seminar
CP: ECTS credit points

3. Detailed Curriculum

	Module	Type[1]	Hours[2]	Exam[3]	CP[4]	CP/ Year
Semester 1	Mathematical Finance	L/T	4/2	o or w	9	
	Advanced Mathematics[5 6]	L/T	4/2	o or w	9	
	Financial Economics I[7]	L/T	2/1	w	5	
	Econometrics I or Advanced Statistics II	L/T	2/2 or 2/1	w	5	
			∑ 19 or 18		**∑ 28**	
Semester 2	Computational Finance	L/T	4/2	o or w	9	
	Mathematical Finance and Stochastic Integration	L/T	4/2	o or w	9	
	Financial Economics II[7]	L/T	2/1	w	5	
	(Econometrics for Financial Markets or Multivariate Time Series Analysis and Forecasting or Univariate Time Series Analysis)[8]	(L/T)	(2/1)	(w)	(4)	
	Seminar[9]	S	2	p	4	
	Internship[10]	I	x	ru	4	
			∑ 17 + x or 20		**∑ 31**	**∑ 59**
Semester 3	Advanced Mathematics[5 6]	L/T	4/2	o or w	9	
	Advanced Mathematical Finance[11]	L/T	2 x 2/1	o or w	10	
	Financial Economics III[7]	L/T	2/1	w	5	
	Statistics for Financial Markets[8]	L/T	2/1	w	4	
	Seminar[9]	S	2	p	4	
			∑ 20 or 17+ x		**∑ 32**	
Semester 4	Research Seminar[12]	S	2	pu	3	
	Master Thesis[13]	T	x	t	26	
			∑ 2+x		**∑ 29**	**∑ 61**

Explanation:

[1] L=lecture, T=tutorial, S=seminar, I=internship, T=thesis

[2] weakly hours (=45 minutes each) during the semester

[3] o=oral, w=written, p=presentation, r=report, t=thesis, u=unmarked

[4] credit points

[5] Can be split into 1-3 modules of altogether 6 hours (L+T)

[6] Can be chosen from the modules in applied and pure mathematics. At least one of the modules is to be chosen from applied (rather than pure) mathematics. Modules are typically taught in English upon request. Suggested courses are Mathematical Statistics (Mathematische Statistik) and Numerics of Differential Equations (Numerik von Differentialgleichungen).

[7] Financial Economics I-III can be chosen from "Economics of Risk and Uncertainty" and from the lectures in the group Financial Economics, i.e. at present 1. International Financial Markets, 2. Theory of Financial Markets, 3. Pricing in Derivative Markets, 4. Foreign Exchange Markets – Theory and Empirics, 5. Applied Econometrics of Foreign Exchange Markets, 6. Advanced Topics in Financial Economics

[8] One can choose either Econometrics for Financial Markets/Multivariate Time Series Analysis and Forecasting/Univariate Time Series Analysis in Semester 2 or Statistics for Financial Markets in Semester 3

[9] Seminar in applied mathematics. At least one seminar must be in the area of Mathematical Finance. One of the seminars can be chosen from the Master's programme Quantitative Finance, subject to admission by the examination board and the organizer.

[10] Can be moved to Semester 3 (depending e.g. on the choice Econometrics vs. Statistics for Financial Markets)[8,] typically in the term break

[11] Advanced Courses in Mathematical Finance as e.g. Risk Management, Interest Rate Theory, Optimization in Mathematical Finance

[12] Research seminar in the area of the Master thesis

[13] The master thesis is supposed to be closely connected to Mathematical Finance. It may be supervised by a professor involved in the Master's programme Quantitative Finance from the faculty of Business, Economics and Social Sciences.

B. Modules

1. Compulsory Section Mathematical Finance

module name	Mathematical Finance			
module code	MNF-math-finmath1			
term / duration	1 / 1 semester			
responsible person for this module	Prof. Dr. Jan Kallsen			
attribution to curriculum	**degree programme**	**status**		
	M.Sc. Mathematical Finance	Compulsory Section in Mathematical Finance		
	M.Sc. Mathematik	Optional module		
courses	**title** **teachers**	**credits** **term**	**status**	**time of attendance**
	lecture +tutorial: Mathematical Finance Prof. Dr. Jan Kallsen	9 ECTS winter	compulsory	l: 4 SWS (60 hrs.) t: 2 SWS (30 hrs.)
credit points and grade	9 ECTS		German Scale, ECTS-System	
workload entire module	270 hours			
language	English			
requirements for performance assessment	Oral or written exam			
educational objectives / competencies	Basic knowledge of mathematical finance			
knowledge transfer	Interactive lecture and tutorial, lecture notes, literature studies, exercises			
Contents	1. Introduction to pricing theory 2. Stochastic foundation of discrete markets 3. Derivative pricing in discrete markets 4. Risk neutral measures and the fundamental theorem of asset pricing 5. Cox-Ross-Rubinstein model 6. American claims and optimal stopping 7. Black Scholes model and Black Scholes formula			
References	• Irle, Albrecht: Mathematical Finance, Teubner. • More references are given in the course.			

module name	Computational Finance			
module code	MNF-math-compfin			
term / duration	2 / 1 semester			
responsible person for this module	Prof. Dr. Jan Kallsen			
attribution to curriculum	**degree programme**	**status**		
	M.Sc. Mathematical Finance	Compulsory Section in Mathematical Finance		
	M.Sc. Mathematik	Optional module		
courses	**title** **teachers**	**credits** **term**	**status**	**time of attendance**
	lecture +tutorial: Computational Finance Prof. Dr. Jan Kallsen	9 ECTS summer	compulsory	l: 4 SWS (60 hrs.) t: 2 SWS (30 hrs.)
credit points and grade	9 ECTS		German Scale, ECTS-System	
workload entire module	270 hours			
language	English			
requirements for performance assessment	Oral or written exam			

educational objectives / competencies	Basic knowledge of computational finance
knowledge transfer	Interactive lecture and tutorial, lecture notes, literature studies, exercises
Contents	1. Derivative pricing 2. Numerical integration 3. Tree based methods 4. Finite difference method 5. Finite element method 6. Monte-Carlo method 7. Integral transform method
References	• References are given in the course.

module name	**Mathematical Finance and Stochastic Integration**			
module code	MNF-math-compfin			
term / duration	2 / 1 semester			
responsible person for this module	Prof. Dr. Jan Kallsen			
attribution to curriculum	**degree programme**	**status**		
	M.Sc. Mathematical Finance	Compulsory Section in Mathematical Finance		
	M.Sc. Mathematik	Optional module		
courses	**title** **teachers**	**credits** **term**	**status**	**time of attendance**
	lecture +tutorial: Mathematical Finance and Stochastic Integration Prof. Dr. Jan Kallsen	9 ECTS summer	compulsory	l: 4 SWS (60 hrs.) t: 2 SWS (30 hrs.)
credit points and grade	9 ECTS		German Scale, ECTS-System	
workload entire module	270 hours			
language	English or German			
requirements for performance assessment	Oral or written exam			
educational objectives / competencies	Basic knowledge of computational finance			
knowledge transfer	Interactive lecture and tutorial, lecture notes, literature studies, exercises			
Contents	1. Stochastic integration 2. Stochastic differntial equations 3. Equivalent martingale measures 4. Hedging of Derivatives in continuous time markets 5. Black-Scholes model and other models for continuous time markets			
References	• References are given in the course.			

2. Advanced Mathematical Finance

module name	Risk Management			
module number	MNF-math-riskman			
term / duration	3 / 1 semester			
responsible person for this module	Prof. Dr. Jan Kallsen			
attribution to curriculum	**degree programme**	**status**		
	M.Sc. Mathematical Finance	Advanced Mathematical Finance		
courses	**title** **teachers**	**credits** **term**	**status**	**time of attendance**
	lecture +tutorial: Risk Management Prof. Dr. Jan Kallsen	5 ECTS winter	compulsory	l: 2 SWS (30 hrs.) t: 1 SWS (15 hrs.)
credit points and grade	5 ECTS		German Scale, ECTS-System	
workload entire module	150 hours			
language	English			
requirements for performance assessment	Active and regular participation Written exam (max. 180 min.) or oral exam (max. 30 min.)			
educational objectives / competencies	Knowledge of models for quantifying financial risks			
knowledge transfer	Interactive lecture and tutorial, lecture notes, literature studies, exercises			
Contents References	1. Credit risk 2. Market risk 3. Operational risk 4. Rating methods 5. Credit portfolio models 6. Credit derivatives and their valuation 7. Risk measures 8. Applications of extreme value theory • Mc Neil, Frey, Embrechts: Quantitative Risk Management.			

module name	Interest Rate Theory (Zinsmodelle)			
module number	MNF-math-zimo			
term / duration	3 / 1 semester			
responsible person for this module	Prof. Dr. Jan Kallsen			
attribution to curriculum	**Degree programme**	**status**		
	M.Sc. Mathematical Finance	Advanced Mathematical Finance		
courses	**title** **teachers**	**credits** **term**	**status**	**time of attendance**
	lecture +tutorial: Zinsmodelle Prof. Dr. Jan Kallsen	5 ECTS winter	compulsory	l: 2 SWS (30 hrs.) t: 1 SWS (15 hrs.)
credit points and grade	5 ECTS		German Scale, ECTS-System	
workload entire module	150 hours			
language	English or German			
requirements for performance assessment	Active and regular participation Written exam (max. 180 min.) or oral exam (max. 30 min.)			
educational objectives / competencies	Acquisition of ability to deal with model from interest rate theory.			
knowledge transfer	Interactive lecture and tutorial, lecture notes, literature studies, exercises			

Contents **References**	1. Basics 2. Interest rate derivatives 3. Short rate models 4. Change of numeraire 5. Affine term structure 6. Factor models 7. Heath-Jarrow-Morton 8. Libor market models
Contents References	Varying, specialized and advanced literature from mathematical finance.

module name	**Optimization in Mathematical Finance (Optimierungsprobleme in der Finanzmathematik)**			
module number	MNF-math-optpro			
term / duration	3 / 1 semester			
responsible person for this module	Prof. Dr. Jan Kallsen			
attribution to curriculum	**degree programme**	**status**		
	M.Sc. Mathematical Finance	Advanced Mathematical Finance		
courses	**title** **teachers**	**credits** **term**	**status**	**time of attendance**
	lecture +tutorial: Optimierungsprobleme in der Mathematical Finance Prof. Dr. Jan Kallsen	5 ECTS winter	compulsory	l: 2 SWS (30 hrs.) t: 1 SWS (15 hrs.)
credit points and grade	5 ECTS		German Scale, ECTS-System	
workload entire module	150 hours			
language	English or German			
requirements for performance assessment	Active and regular participation Written exam (max. 180 min.) or oral exam (max. 30 min.)			
educational objectives / competencies	Acquisition of ability to deal with optimization problems from mathematical finance.			
knowledge transfer	Interactive lecture and tutorial, lecture notes, literature studies, exercises			
Contents **References**	1. Optimal stopping 2. Portfolio optimization 3. Hedging problems 4. Stochastic control 5. Martingale methods			

module name	**Models with Jumps in Mathematical Finance (Sprungmodelle in der Finanzmathematik)**			
module number	MNF-math-sppro			
term / duration	3 / 1 semester			
responsible person for this module	Prof. Dr. Jan Kallsen			
attribution to curriculum	**Degree programme**	**status**		
	M.Sc. Mathematical Finance	Advanced Mathematical Finance		
courses	**title** **teachers**	**credits** **term**	**status**	**time of attendance**
	lecture +tutorial: Sprungmodelle in der Mathematical Finance Prof. Dr. Jan Kallsen	5 ECTS n.s.	compulsory	l: 2 SWS (30 hrs.) t: 1 SWS (15 hrs.)
credit points and grade	5 ECTS		German Scale, ECTS-System	
workload entire module	150 hours			
language	English or German			
requirements for performance assessment	Active and regular participation Written exam (max. 180 min.) or oral exam (max. 30 min.)			
educational objectives / competencies	Acquisition of ability to deal with models with jumps in mathematical finance.			
knowledge transfer	Interactive lecture and tutorial, lecture notes, literature studies, exercises			
Contents **References**	1. Levy processes 2. Stochastic calculus for jump processes 3. Markets, strategies, arbitrage, derivatives 4. Variance-optimal hedging 5. Utility indifference pricing and hedging			

module name	**Actuarial Mathematics and Risk Theory (Versicherungsmathematik und Risikotheorie)**			
module number	MNF-math-veri			
term / duration	3 / 1 semester			
responsible person for this module	Prof. Dr. Jan Kallsen			
attribution to curriculum	**degree programme**	**status**		
	M.Sc. Mathematical Finance	Advanced Mathematical Finance		
courses	**title** **teachers**	**credits** **term**	**status**	**time of attendance**
	lecture +tutorial: Actuarial Mathematics and Risk Theory Prof. Dr. Jan Kallsen	5 ECTS Summer	compulsory	l: 2 SWS (30 hrs.) t: 1 SWS (15 hrs.)
credit points and grade	5 ECTS		German Scale, ECTS-System	
workload entire module	150 hours			
language	English or German			
requirements for performance assessment	Active and regular participation Written exam (max. 180 min.) or oral exam (max. 30 min.)			
educational objectives / competencies	Acquisition of basic knowledge of risk theory with focus on non-life insurance.			
knowledge transfer	Interactive lecture and tutorial, lecture notes, literature studies, exercises			
Contents **References**	1. Models for the claim number process 2. Fitting the claim size distribution 3. Collective risk model 4. Ruin theory 5. Insurance premium principles			

module name	Current Issues in Mathematical Finance (Aktuelle Probleme der Finanzmathematik)			
module number	MNF-math-probl_fima			
term / duration	3 / 1 semester			
responsible person for this module	Prof. Dr. Jan Kallsen			
attribution to curriculum	**degree programme**	**status**		
	M.Sc. Mathematical Finance	Advanced Mathematical Finance		
courses	**title** **teachers**	**credits** **term**	**status**	**time of attendance**
	lecture +tutorial: rent Issues in Mathematical Finance Prof. Dr. Jan Kallsen	5 ECTS winter	compulsory	l: 2 SWS (30 hrs.) t: 1 SWS (15 hrs.)
credit points and grade	5 ECTS		German Scale, ECTS-System	
workload entire module	150 hours			
language	English or German			
requirements for performance assessment	Active and regular participation Written exam (max. 180 min.) or oral exam (max. 30 min.)			
educational objectives / competencies	Acquisition of ability to deal with recent research topics from the field of mathematical finance.			
knowledge transfer	Interactive lecture and tutorial, lecture notes, literature studies, exercises			
Contents References	Recent developments in the field of mathematical finance. • A detailed outline and references will be announced in preliminary to the course.			

module name	Current Issues in Computational Finance (Aktuelle Probleme aus Numerik und Finanzmathematik)			
module number	MNF-math-prbl_fe			
term / duration	3 / 1 semester			
responsible person for this module	Prof. Dr. Jan Kallsen			
attribution to curriculum	**degree programme**	**status**		
	M.Sc. Mathematical Finance	Advanced Mathematical Finance		
courses	**title** **teachers**	**credits** **term**	**status**	**time of attendance**
	lecture +tutorial: Aktuelle Probleme aus Numerik und Prof. Dr. Jan Kallsen	5 ECTS winter	compulsory	l: 2 SWS (30 hrs.) t: 1 SWS (15 hrs.)
credit points and grade	5 ECTS		German Scale, ECTS-System	
workload entire module	150 hours			
language	English or German			
requirements for performance assessment	Active and regular participation Written exam (max. 180 min.) or oral exam (max. 30 min.)			
educational objectives / competencies	Acquisition of ability to deal with recent research topics from the field of financial engineering.			
knowledge transfer	Interactive lecture and tutorial, lecture notes, literature studies, exercises			
Contents References	Recent Developments in the field of financial engineering. • A detailed outline and references will be announced in preliminary to the course.			

3. Advanced Mathematics

module name	**Mathematical Statistics**			
module code	MNF-math-stat.1			
term / duration	1 or 3 / 1 semester			
responsible person for this module	Prof. Dr. Jan Kallsen			
attribution to curriculum	**degree programme**	**status**		
	M.Sc. Mathematical Finance	Advanced Mathematics		
	M.Sc. Mathematik	Optional module		
courses	**title** **credits** **teachers** **term**		**status**	**time of attendance**
	lecture +tutorial: Mathematical Statistics 9 ECTS Prof. Dr. Jan Kallsen winter		compulsory	l: 4 SWS (60 hrs.) t: 2 SWS (30 hrs.)
credit points and grade	9 ECTS		German Scale, ECTS-System	
workload entire module	270 hours			
language	English or German			
requirements for performance assessment	Oral or written exam			
educational objectives / competencies	Basic knowledge of mathematical statistics			
knowledge transfer	Interactive lecture and tutorial, lecture notes, literature studies, exercises			
Contents **References**	1. Statistical modelling 2. Optimal estimators 3. Linear models 4. Maximum likelihood estimation 5. Optimal tests 6. Confidence regions 7. Consolidations and supplements • References are given in the course.			

module name	Stochastic Processes			
module code	MNF-math-stpr.1			
term / duration	1 or 3 / 1 semester			
responsible person for this module	Prof. Dr. Uwe Rösler			
attribution to curriculum	**degree programme**	**status**		
	M.Sc. Mathematical Finance	Advanced Mathematics		
	M.Sc. Mathematik	Optional module		
courses	**title** **teachers**	**credits** **term**	**status**	**time of attendance**
	lecture +tutorial: Stochastic processes Prof. Dr. Uwe Rösler	9 ECTS winter	compulsory	l: 4 SWS (60 hrs.) t: 2 SWS (30 hrs.)
credit points and grade	9 ECTS		German Scale, ECTS-System	
workload entire module	270 hours			
language	English or German			
requirements for performance assessment	Oral or written exam			
educational objectives / competencies	Basic knowledge of stochastic processes			
knowledge transfer	Interactive lecture and tutorial, lecture notes, literature studies, exercises			
Contents	1. Stochastic processes based on measure theory 2. Markov chains and Markov processes 3. Wiener process and Poisson process 4. Point processes 5. Branching processes 6. Simulation 7. Consolidations and supplements			
References	• References are given in the course.			

module name	Numerics for Differential Equations			
module code	MNF-math-numdglmsc			
term / duration	1 or 3 / 1 semester			
responsible person for this module	Prof. Dr. Malte Braack			
attribution to curriculum	**degree programme**	**status**		
	M.Sc. Mathematical Finance	Advanced Mathematics		
	M.Sc. Mathematik	Optional module		
courses	**title** **teachers**	**credits** **term**	**status**	**time of attendance**
	lecture +tutorial: Prof. Dr. Steffen Börm Prof. Dr. Malte Braack Prof. Dr. Thomas Slawig	9 ECTS summer	compulsory	l: 4 SWS (60 hrs.) t: 2 SWS (30 hrs.)
credit points and grade	9 ECTS		German Scale, ECTS-System	
workload entire module	270 hours			
language	German or English			
requirements for performance assessment	Oral or written exam			
educational objectives / competencies	Basic knowledge of numerical methods for solving differential equations			
knowledge transfer	Interactive lecture and tutorial, lecture notes, literature studies, exercises			
Contents	Numerical methods for • Initial value problems • Boundary problems • Differential-algebraic equations • Elliptical partial differential equations			
References	• References are given in the course.			

Further modules are to be found in the Module Manual Mathematics. They are typically taught in English upon request.

4. Financial Economics

module name	**Economics of Risk and Uncertainty**			
module number	VWL-PuEc-EcRU			
term / duration	1-3/ 1 semester			
responsible person for this module	Prof. Dr. Ulrich Schmidt			
attribution to curriculum	**degree programme**	**status**		
	M.Sc. Economics	Optional Section in Economics		
	M.Sc. Env. And Res. Economics	Optional Section in Economics		
	M.Sc. Quantitative Economics	Optional Section in Economics		
	M.Sc. Quantitative Finance	Optional Section in Financial Economics		
	M. Sc. Quantitative Economics	Minor Subject Economics		
	M. Sc. Quantitative Finance	Minor Subject Economics		
	M.Sc. Informatik	Anwendungsgebiet Volkswirtschaftslehre		
	M.Sc. Mathematik	Nebenfach in Economics		
	M.Sc. Mathematical Finance	Financial Economics		
courses	**title** **teachers**	**credits** **term**	**status**	**time of attendance**
	lecture + tutorial: Economics of Risk and Uncertainty Prof. Dr. Ulrich Schmidt	5 ECTS summer	elective	l: 2 SWS (30 hrs.) t: 1 SWS (15 hrs.)
credit points and grade	5 ECTS		German Scale, ECTS-System	
workload entire module	150 hours			
language	English			
requirements for performance assessment	written exam			
educational objectives / competencies	Students should become familiar with modern concepts and theories of decision-making under risk as well as possible applications in finance and insurance economics. They should be enabled to analyze decision problems under risk independently.			
knowledge transfer by lectures + tutorials	Interactive lecture and tutorial, lecture notes, literature studies, exercises			
Contents	1. Introduction 2. Expected Utility 3. Non-expected Utility 4. Applications to insurance economics 5. Applications to financial markets			
References	• Schmidt, U., Alternatives to Expected Utility: Some Formal Theories, in: S. Barberà, P.J. Hammond and C. Seidl (eds.), *Handbook of Utility Theory, Vol. II*, Kluwer, Boston, 2004. • Bleichrodt, H. And U. Schmidt, Applications of Non-Expected Utility, in: P. Anand and C. Puppe (eds.), Handbook of Rational and Social Choice, Oxford University Press, 2009.			

module name	International Financial Markets			
module code	VWL-FinEc-IPF			
term / duration	1-3/ 1 semester			
responsible person for this module	Prof. Dr. Thomas Lux			
attribution to curriculum	**degree programme**	**Status**		
	M.Sc. Economics	Optional Section in Economics		
	M.Sc. Env. And Res. Economics	Optional Section in Economics		
	M.Sc. Quantitative Economics	Optional Section in Economics		
	M.Sc. Quantitative Finance	Optional Section in Financial Economics		
	M.Sc. Quantitative Economics	Minor Subject Economics		
	M.Sc. Informatik	Anwendungsgebiet Volkswirtschaftslehre		
	M.Sc. Mathematical Finance	Financial Economics		
	M.Sc. Mathematik	Nebenfach in Economics		
	M.Sc. Wirtschaftsinformatik	Vertiefung in VWL		
courses	**title** **teachers**	**credits** **term**	**status**	**time of attendance**
	lecture + tutorial: International Financial Markets Prof. Dr. Thomas Lux	5 ECTS summer	elective	l: 2 SWS (30 hrs.) t: 1 SWS (15 hrs.)
credit points and grade	5 ECTS		German Scale, ECTS-System	
workload entire module	150 hours			
language	English			
requirements for performance assessment	written exam			
educational objectives / competencies	The lecture covers modern theories that view foreign exchange markets and exchange rate determination from a finance perspective. Relevant topics include the importance of investors' expectations and speculative behavior in the foreign exchange market and its explanatory power for the observation of excessive volatility of foreign exchange rates compared to macroeconomic fundamentals. We also discuss the effects of political interventions to curb speculative activity and the determinants of major historical currency crises.			
knowledge	Interactive lecture and tutorial, lecture notes, literature studies, exercises			

module name	Theory of Financial Markets			
module code	VWL-FinEc-TFM			
term / duration	1-3/ 1 semester			
responsible person for this module	Prof. Dr. Thomas Lux			
attribution to curriculum	**degree programme**	**Status**		
	M.Sc. Economics	Optional Section in Economics		
	M.Sc. Env. And Res. Economics	Optional Section in Economics		
	M.Sc. Quantitative Economics	Optional Section in Economics		
	M.Sc. Quantitative Finance	Optional Section of Financial Economics		
	M.Sc. Quantitative Economics	Minor Subject Economics		
	M.Sc. Informatik	Anwendungsgebiet Volkswirtschaftslehre		
	M.Sc. Mathematical Finance	Financial Economics		
	M.Sc. Mathematik	Nebenfach in Economics		
	M.Sc. Wirtschaftsinformatik	Vertiefung in VWL		
courses	**title** **teachers**	**credits** **term**	**status**	**time of attendance**
	lecture + tutorial: Theory of Financial Markets Prof. Dr. Thomas Lux	5 ECTS winter	elective	l: 2 SWS (30 hrs.) t: 1 SWS (15 hrs.)
credit points and grade	5 ECTS		German Scale, ECTS-System	
workload entire module	150 hours			
language	English			
requirements for performance assessment	written exam			
educational objectives / competencies	After an introduction to the empirical stylized facts of financial markets, the lecture discusses the theoretical foundations and the empirical validity of the seminal 'efficient market hypothesis'. We continue with models of price formation in accordance with rational information revelation through transactions and also review approaches in the recent 'behavioral finance' literature that emphasize the role of speculative activity and bounded rational behavior of investors.			
knowledge	Interactive lecture and tutorial, lecture notes, literature studies, exercises			
Contents	1. "Stylized facts" of financial market data a. The random walk property of prices b. The distributional properties of returns c. The dynamics of volatility 2. Financial market efficiency and the problem of information transmission a. Equilibrium prices and the "efficient market hypothesis" (EMH) b. The Grossman/Stiglitz-paradoxon of the impossibility of informational efficiency markets c. The revelation of information through transactions d. Information transmission under strategic behavior 3. Pricing on incomplete markets a. Speculation: Stabilizing or destabilizing? i. Keynes vs. Friedman: A survey of older approaches ii. The theory of rational speculative bubbles iii. "Bounded rational" speculation: models with chartists and fundamentalists b. "Noise trading": Survival with wrong information c. Imitation and development of speculative bubbles d. Explanation of stylized facts in "artificial" financial market models 4. Bank panics, financial crises and the hypothesis of the fragility of the financial sector • Aschinger, G.: Börsenkrach und Spekulation: Eine ökonomische Analyse. München 1995			

References	• Barucci, E.: Financial Markets Theory: Equilibrium, Efficiency and Information. London 2003 • Brunnermeiner, M.K.: Asset Pricing under Asymmetric Information. Oxford 2001 • Campell, J./ Lo, A./ MacKinlay, A.: The Econometrics of Financial Markets. Princeton 1997. • Cuthbertson, K.: Quantitative Financial Economics: Stocks, Bonds and Foreign Exchange. New York 1996 • Dacorogna, M.M. / Gencay, R. / Müller, U.A./ Olsen, R.B./ Pictet, O.V.: An Introduction to High-Frequency Finance. New York, London 2001. • O´Hara, M.: Market Microstructure Theory. Oxford 1995

	Pricing in Derivative Markets			
module code	VWL-FinEc-PDM			
term / duration	1-3/ 1 semester			
responsible person for this module	Prof. Dr. Thomas Lux			
attribution to curriculum	**degree programme**	**Status**		
	M.Sc. Economics	Optional Section in Economics		
	M.Sc. Env. And Res. Economics	Optional Section in Economics		
	M.Sc. Quantitative Economics	Optional Section in Economics		
	M.Sc. Quantitative Finance	Optional Section in Financial Economics		
	M.Sc. Quantitative Economics	Minor Subject Economics		
	M.Sc. Informatik	Anwendungsgebiet Volkswirtschaftslehre		
	M.Sc. Mathematical Finance	Financial Economics		
	M.Sc. Mathematik	Nebenfach in Economics		
	M.Sc. Wirtschaftsinformatik	Vertiefung in VWL		
courses	**title** **teachers**	**credits** **term**	**status**	**time of attendance**
	lecture + tutorial: Pricing in Derivative Markets Prof. Dr. Thomas Lux	5 ECTS winter	elective	l: 2 SWS (30 hrs.) t: 1 SWS (15 hrs.)
credit points and grade	5 ECTS		German Scale, ECTS-System	
workload entire module	150 hours			
language	English			
requirements for performance assessment	written exam			
educational objectives / competencies	The course provides an introduction to the pricing of financial derivatives and is logically split into two parts. The first part deals with the mechanics of derivative markets and instruments. The second part focuses on the mathematical concepts that are used to price these derivatives, often summarized under the catch-all phrase of financial engineering.			
knowledge	Interactive lecture and tutorial, lecture notes, literature studies, exercises			
Contents	The first part of the course covers the mechanics: 1. Introduction, conventions, examples 2. Forwards and futures 3. Simple interest rate derivatives 4. Swaps 5. Options The second part of the course deals with pricing tools: 1. Binomial trees 2. Black-Scholes-Merton approach to option pricing 3. General concept of synthetic replication 4. Equivalent martingale measures 5. Credit risk and credit derivatives			
References	• Hull, J. "Options, Futures and Other Derivatives", 6. ed., Prentice Hall, 2006 • Neftci, S.: "Principles of Financial Engineering", Elsevier AP, 2004 • Jarrow, R.: "Modelling Fixed Income Securities and Interest Rate Options", 2. ed., Stanford University Press, 2002. • Jarrow, R. and S. Turnbull: "Derivative Securities", 2. ed., Academic Press, 2000.			

module name	Foreign Exchange Markets - Theory and Empirics			
module code	VWL-FinEc-FEM			
term / duration	1-3/ 1 semester			
responsible person for this module	Prof. Dr. Stefan Reitz			
attribution to curriculum	**degree programme**	**Status**		
	M.Sc. Economics	Optional Section in Economics		
	M.Sc. Env. And Res. Economics	Optional Section in Economics		
	M.Sc. Quantitative Economics	Optional Section in Economics		
	M.Sc. Quantitative Finance	Optional Section in Financial Economics		
	M.Sc. Quantitative Economics	Minor Subject Economics		
	M.Sc. Informatik	Anwendungsgebiet Volkswirtschaftslehre		
	M.Sc. Mathematical Finance	Financial Economics		
	M.Sc. Mathematik	Nebenfach in Economics		
	M.Sc. Wirtschaftsinformatik	Vertiefung in VWL		
courses	**title** **teachers**	**credits** **term**	**status**	**time of attendance**
	lecture: Foreign Exchange Markets-Theory and Empirics Prof. Dr. Stefan Reitz	5 ECTS winter	compulsory elective	l: 2 SWS (30 hrs.) t: 1 SWS (15 hrs.)
credit points and grade	5 ECTS		German Scale, ECTS-System	
workload entire module	150 hours			
language	English			
requirements for performance assessment	written exam			
educational objectives / competencies	The lecture provides an introduction to market microstructure of foreign exchange trading. The role of order flow and inventory risk management is analyzed in a theoretical and an empirical framework. In addition, the trading perspectives of importers/exporters, international investors, and policy makers are discussed by deriving and empirically testing equilibrium relationships in foreign exchange markets.			
knowledge	Interactive lecture and tutorial, lecture notes, literature studies, exercises			
Contents	1. Description of Foreign Exchange Trading 1.1. FX Instruments 1.2. FX Market Segments 1.3. FX Market Participants 2. The Dealers' Perspective 2.1. The Single Dealer Approach 2.2. Dealer Trading in Segmented Markets 2.3. The Multiple Dealer Approach 3. The Customers' Perspective 3.1. Importers / Exporters 3.2. International Investors 4. The Policy Makers' Perspective 4.1. Policy Makers' Perception of FX Performance 4.2. Policy Options			
References	• Lyons, R.: The Microstructure Approach to Exchange Rates, MIT Press Cambridge, MA., 2001 • Sarno, L./ Taylor, M.: "The Economics of Exchange Rates". Cambridge University Press, Cambridge 2002. • Deutsche Bundesbank: "The Microstructure Approach to Exchange Rate Theory", Monthly Bulletin 1/2008			

module name	Applied Econometrics of Foreign Exchange Markets			
module code	VWL-FinEc-AEFE			
term / duration	1-3/ 1 semester			
responsible person for this module	Prof. Dr. Reitz			
attribution to curriculum	**degree programme**	**Status**		
	M.Sc. Economics	Optional Section in Economics (replacement)		
	M.Sc. Env. And Res. Economics	Optional Section in Economics (replacement)		
	M.Sc. Quantitative Economics	Optional Section in Statistic and Econometrics		
	M.Sc. Quatitative Finance	Optional Section in Financial Economics		
	M. Sc. Economics	Minor Subject Empirical Economics		
	M. Sc. Quantitative Economics	Minor Subject Empirical Economics		
	M.Sc. Betriebswirtschaftslehre	Ergänzungsbereich		
	M.Sc. Mathematical Finance	Financial Economics		
	M.Sc. Mathematik	Nebenfach Volkswirtschaftslehre		
	M.Sc. Wirtschaftsinformatik	Vertiefung VWL		
	M.Sc. Informatik	Anwendungsgebiet Volkswirtschaftslehre		
courses	**title** / **teachers**	**credits** / **term**	**status**	**time of attendance**
	lecture: Applied Econometrics of Foreign Exchange Markets Prof. Dr. Reitz	5 ECTS Summer	elective	l: 2 SWS (30 hrs.) t: 1 SWS (15 hrs.)
credit points and grade	5 ECTS		German Scale, ECTS-System	
workload entire module	150 hours			
language	English			
requirements for performance assessment	written exam			
educational objectives / competencies	The course introduces into empirical analysis of modern exchange rate economics. After providing an introduction to RATS programming important concepts of exchange rate economics such as purchasing power parity, uncovered interest parity, ARCH effect in FX returns are econometrically tested using data from various sources. At the end of this practitioners' course participants will be able to derive empirical results from their own econometric programs.			
knowledge	Interactive lecture and tutorial, lecture notes, literature studies, exercises			
Contents	1. Introduction to RATS programming 2. Selected concepts of exchange rate economics and their empirical applications 3. Introduction to current research topics			
References	• Brooks, C., RATS Handbook for Introductory Econometrics for Finance, Cambridge University Press 2008.			

module name	Advanced Topics in Financial Economics			
module code	VWL-FinEc-Adv			
term / duration	1-3/ 1 semester			
responsible person for this module	Prof. Dr. Thomas Lux			
attribution to curriculum	**degree programme**	**Status**		
	M.Sc. Economics	Optional Section in Economics		
	M.Sc. Env. And Res. Economics	Optional Section in Economics		
	M.Sc. Quantitative Economics	Optional Section in Economics		
	M.Sc. Quantitative Finance	Optional Section in Financial Economics		
	M.Sc. Quantitative Economics	Minor Subject Economics		
	M.Sc. Informatik	Anwendungsgebiet Volkswirtschaftslehre		
	M.Sc. Mathematical Finance	Financial Economics		
	M.Sc. Mathematik	Nebenfach in Economics		
	M.Sc. Wirtschaftsinformatik	Vertiefung in VWL		
courses	**title** **teachers**	**credits** **term**	**status**	**time of attendance**
	lecture: Advanced Topics in Financial Economics N.N.	5 ECTS n.s.	elective	l: 2 SWS (30 hrs.) t: 1 SWS (15 hrs.)
credit points and grade	5 ECTS		German Scale, ECTS-System	
workload entire module	150 hours			
language	English			
requirements for performance assessment	written exam			
educational objectives / competencies	t.b.a.			
knowledge	Interactive lecture and tutorial, lecture notes, literature studies, exercises			
Contents References	Varying topics in the field of financial economics. This course only takes place occasionally.			

5. Econometrics and Statistics

module name	**Advanced Statistics II**			
module number / PNr	VWL-AdvStatII / 42310			
term / duration	2-3/ 1 semesters			
responsible person for this module	Prof. Dr. Matei Demetrescu			
attribution to curriculum	**degree programme**	**status**		
	M.Sc. Quantitative Economics	Compulsory Section in Statistics and Econometrics		
	M.Sc. Quantitative Finance	Compulsory Section in Econometrics for Finance		
	M.Sc. Economics	Optional Section in Economics(replacement)		
	M.Sc. Env. And Res. Economics	Optional Section in Economics (replacement)		
	M.Sc. Economics	Minor Subject Empirical Economics		
	M.Sc. Betriebswirtschaftslehre	Ergänzungsbereich		
	M.Sc. Mathematical Finance	Econometrics and Statistics		
	M.Sc. Mathematik	Nebenfach Statistics and Econometrics		
	M.Sc. Wirtschaftsinformatik	Vertiefung in VWL		
courses	**title** **teachers**	**credits** **term**	**status**	**time of attendance**
	lecture + tutorial: Advanced Statistics II Prof. Dr. Matei Demetrescu	5 ECTS summer	compulsory elective	l: 2 SWS (30 hrs.) t: 1 SWS (15 hrs.)
credit points and grade	5 ECTS		German Scale, ECTS-System	
workload entire module	150 hours			
language	English			
requirements for performance assessment	written exam			
educational objectives / competencies	The course allows the students to become familiar with, to understand and to apply the concepts of mathematical statistics underlying the procedures of statistical inference on which the statistical and econometric analysis of economic data are based. The focus in the second part is on inferential theory.			
knowledge transfer by lectures + tutorials	Interactive lecture and tutorial, lecture notes, literature studies, exercises			
Contents	1. Elements of Point Estimation 2. Point Estimation Methods 3. Hypothesis Testing 4. Introduction to Statistical Software			
References	• Mittelhammer, R.C.(1996), Mathematical Statistics for Economics and Business. Springer-Verlag, New-York. • Mood, A.M., Graybill, F.A.and D.C. Boes (1974), Introduction to the Theory of Statistics. McGraw Hill, Boston. • Casella, G.and R.Berger (2002). Statistical Inference. Pacific Grove: Duxbury.			

module name	Econometrics I			
module code	VWL-EcoI			
term / duration	1 / 1 semester			
responsible person for this module	Prof. Dr. Carstensen			
attribution to curriculum	**degree programme**	**status**		
	M.Sc. Env. And Res. Economics	Compulsory Section in Econometrics		
	M.Sc. Economics	Compulsory Section in Econometrics		
	M.Sc. Quantitative Economics	Compulsory Section in Statistics and Econometrics		
	M.Sc. Quantitative Finance	Compulsory Section Econometrics for Finance		
	M.Sc. Betriebswirtschaftslehre	Minor Subject Statistics and Econometrics		
	M.Sc. Mathematical Finance	Econometrics and Statistics		
	M.Sc. Mathematik	Minor Subject Statistics and Econometrics		
	M.Sc. Wirtschaftsinformatik	Specialization Economics		
courses	**title** / **teachers**	**credits** / **term**	**status**	**time of attendance**
	lecture +tutorial: Econometrics I Prof. Dr. Carstensen	5 ECTS winter	compulsory	l: 2 SWS (30 hrs.) t: 2 SWS (30 hrs.)
credit points and grade	5 ECTS		German Scale, ECTS-System	
workload entire module	150 hours			
language	English			
requirements for performance assessment	written exam			
educational objectives / competencies	The lecture covers important estimation and inference techniques for cross-sectional data and introduces into the use of the econometric software packages Gretl and Stata.			
knowledge transfer	Interactive lecture and tutorial, lecture notes, literature studies, exercises			
Contents References	1. Linear Models a. The Single-Equation Model and OLS Estimation b. Instrumental Variables Estimation of Single-Equation Models c. Additional Single-Equation Topics d. The SUR model e. The Simultaneous Equations Model 2. Nonlinear Models a. M-Estimation b. Maximum Likelihood Estimation c. Generalized Method of Moments Estimation 3. Binary Response Models Textbook: Jeffrey M Wooldridge (2010), Econometric Analysis of Cross Section and Panel Data, 2nd edition, MIT Press.			

module name	Econometrics for Financial Markets			
module number	VWL-AEM-EcFin			
term / duration	2-3 / 1 semester			
responsible person for this module	Prof. Dr. Markus Haas			
attribution to curriculum	**degree programme**	**status**		
	M. Sc. Quantitative Finance	Compulsory Section Econometrics For Finance		
	M.Sc. Economics	Optional Section in Economics(replacement)		
	M.Sc. Env. And Res. Economics	Optional Section in Economics(replacement)		
	M.Sc. Quantitative Economics	Optional Section in Statistic and Econometrics		
	M. Sc. Economics	Minor Subject Empirical Economics		
	M. Sc. Quantitative Economics	Minor Subject Empirical Economics		
	M.Sc. Betriebswirtschaftslehre	Ergänzungsbereich		
	M.Sc. Mathematik	Nebenfach Statistics and Econometrics		
	M.Sc. Mathematical Finance	Econmetrics and Statistics for Financial Markets		
	M.Sc. Wirtschaftsinformatik	Vertiefung in VWL		
courses	**title** **teachers**	**credits** **term**	**status**	**time of attendance**
	lecture + tutorial: Econometrics for Financial Markets Prof. Dr. Markus Haas	5 ECTS summer	elective	l: 2 SWS (30 hrs.) t: 1 SWS (15 hrs.)
credit points and grade	5 ECTS		German Scale, ECTS-System	
workload entire module	150 hours			
language	English			
requirements for performance assessment	Written exam			
educational objectives / competencies	This course offers the possibility for the students to become familiar with special econometric techniques required to work with financial market data. Students will get familiar with stylized facts of financial market data and shall learn how to take the latter into account within the framework of (multivariate) dynamic modelling. Each theoretical progress will be followed by an introduction tothe software package Matlab and EViews for practical exercises with some data. From the applied part, students will get the ability to solve typical issues arising in portfolio management and asset pricing (CAPM, option pricing, Value-at-risk). The variety of parametric and nonparametric modeling approaches will enable students to critically assess relative model performance, which is crucial in financial practice.			
knowledge transfer by lectures + tutorials	Interactive lecture and tutorial, lecture notes, literature studies, exercises			
Contents	1. Stylized Facts of Financial Market Data 2. Univariate (G)ARCH Models 3. Multivariate GARCH Models 4. Realized Volatility 5. Applications: Dynamic CAPM, Option Pricing under Heteroskedasticity, Value-at-risk			
References	• Andersen, T.G., T. Bollerslev, F.X. Diebold, P. Labys (2003): Modeling and Forecasting Realized Volatility; Econometrica, 71, 579–625. • Bauwens, L., S. Laurent, J.V.K. Rombouts (2003): Multivariate GARCH Models: A Survey, Journal of Applied Econometrics, 21, 79--109. • Duan, J.-C. (1995): The GARCH Option Pricing Model, Mathematical Finance 5, 13–32. • Herwartz, H. (2005): Conditional Heteroskedasticity, in: Lütkepohl, H., Krätzig, M.: Applied Time Series Analysis, Chap. 5, Cambridge University Press.			

module name	Multivariate Time Series Analysis and Forecasting			
module number	VWL-AEM-MTSA			
term / duration	2-3 / 1 semester			
responsible person for this module	Prof. Dr. Kai Carstensen			
attribution to curriculum	**degree programme**	**status**		
	M.Sc. Economics	Optional Section in Economics(replacement)		
	M.Sc. Env. And Res. Economics	Optional Section in Economics(replacement)		
	M.Sc. Quantitative Economics	Optional Section in Statistic and Econometrics		
	M.Sc. Economics	Minor Subject Empirical Economics		
	M.Sc. Quantitative Economics	Minor Subject Empirical Economics		
	M.Sc. Quantitative Finance	Minor Subject Empirical Economics		
	M.Sc. Betriebswirtschaftslehre	Minor Subject Statistics and Econometrics		
	M.Sc. Mathematik	Minor Subject Statistics and Econometrics		
	M.Sc. Mathematical Finance	Econmetrics and Statistics for Financial Markets		
courses	**title** **teachers**	**credits** **term**	**status**	**time of attendance**
	lecture + tutorial: Multivariate Time Series Analysis and Forecasting Prof. Dr. Kai Carstensen	5 ECTS summer	elective	l: 2 SWS (30 hrs.) t: 1 SWS (15 hrs.)
credit points and grade	5 ECTS		German Scale, ECTS-System	
workload entire module	150 hours			
language	English			
requirements for performance assessment	Take-away exams, written exam at the end of the semester			
educational objectives / competencies	The lecture offers an introduction to the vector autoregressive (VAR) model, the workhorse model for multivariate time series analysis. This includes aspects of specification, estimation, forecasting, and (structural) interpretation. In addition, selected topics in forecasting and forecast evaluation are presented. . In the tutorial, students solve methodological and applied problem sets, and use the scientific software Matlab.			
knowledge transfer by lectures + tutorials	Interactive lecture and tutorial, lecture notes, literature studies, exercises			
Contents References	• Stable Vector Autoregressive Processes • Estimation of Vector Autoregressive Processes • Forecasting with VAR models • VAR Order Selection and Checking the Model Adequacy • Structural VARs • VAR Models with Time-Varying Parameters • Forecast evaluation and comparison • Helmut Lütkepohl (2007), New Introduction to Multiple Time Series Analysis, Springer-Verlag, Berlin. • F.X. Diebold and R.S. Mariano (1995) Comparing predictive accuracy, Journal of Business and Economic Statistics 13, 253-263. • R.S. Mariano (2007) Testing forecast accuracy, in: A Companion to Economic Forecasting (eds. M. P. Clements and D. F. Hendry), Blackwell.			

module name	**Statistics for Financial Markets**			
module number	VWL-AEM-StatFin			
term / duration	2-3 / 1 semester			
responsible person for this module	Prof. Dr. Markus Haas			
attribution to curriculum	**degree programme**	**status**		
	M.Sc. Economics	Optional Section in Economics(replacement)		
	M.Sc. Env. And Res. Economics	Optional Section in Economics(replacement)		
	M.Sc. Quantitative Economics	Optional Section in Statistic and Econometrics		
	M.Sc. Economics	Minor Subject Empirical Economics		
	M.Sc. Quantitative Economics	Minor Subject Empirical Economics		
	M.Sc. Quantitative Finance	Compulsory Section Econometrics for Finance		
	M.Sc. Betriebswirtschaftslehre	Ergänzungsberich		
	M.Sc. Mathematik	Nebenfach Statistics and Econometrics		
	M.Sc. Mathematical Finance	Econmetrics and Statistics for Financial Markets		
	M.Sc. Wirtschaftsinformatik	Vertiefung in VWL		
courses	**title** **teachers**	**credits** **term**	**status**	**time of attendance**
	lecture + tutorial: Statistics for Financial Markets Prof. Dr. Markus Haas	5 ECTS winter	elective	l: 2 SWS (30 hrs.) t: 1 SWS (15 hrs.)
credit points and grade	5 ECTS		German Scale, ECTS-System	
workload entire module	150 hours			
language	English			
requirements for performance assessment	Written exam			
educational objectives / competencies	For the students to become familiar with statistical methods used to analyze financial data. These methods include test procedures used for an empirical investigation of the efficiency of financial markets, statistical models for the volatility of asset returns and for high-frequency data, and statistical concepts used to measure the market risk in risk management. Students will practice the use of these statistical methods using the software packages Eviews and Matlab.			
knowledge transfer by lectures + tutorials	Interactive lecture and tutorial, lecture notes, literature studies, exercises			
Contents	1. Introduction: Asset Returns and Their Properties 2. Forecasting Asset Returns and Market Efficiency 3. Volatility Models For Return Series: ARCH-, GARCH-, and Stochastic Volatility Models 4. Market Microstructure and High-Frequency Data 5. Value at Risk and Extreme Value Theory			
References	• Campbell, J.Y., A.W. Lo, A.C. MacKinlay (1997): The Econometrics of Financial Markets, Princeton University Press. • Hamilton, J.D. (1994): Time Series Analysis, Princeton University Press, Princeton, New Jersey. • Taylor, S. (2005): Asset Price Dynamics, Volatility, and Prediction. Princeton University Press. • Tsay, R. (2005): Analysis of Financial Time Series. John Wiley & Sons, New York.			

module name	**Univariate Time Series Analysis**			
module number	VWL-AEM-UTSA			
term / duration	2-3 / 1 semester			
responsible person for this module	Prof. Dr. Matei Demetrescu			
attribution to curriculum	**degree programme**	**status**		
	M.Sc. Economics	Optional Section in Economics(replacement)		
	M.Sc. Env. And Res. Economics	Optional Section in Economics(replacement)		
	M.Sc. Quantitative Economics	Optional Section in Statistic and Econometrics		
	M.Sc. Economics	Minor Subject Empirical Economics		
	M.Sc. Quantitative Economics	Minor Subject Empirical Economics		
	M.Sc. Quantitative Finance	Minor Subject Empirical Economics		
	M.Sc. Betriebswirtschaftslehre	Minor Subject Statistics and Econometrics		
	M.Sc. Mathematik	Minor Subject Statistics and Econometrics		
	M.Sc. Mathematical Finance	Econmetrics and Statistics for Financial Markets		
courses	**title** **teachers**	**credits** **term**	**status**	**time of attendance**
	lecture + tutorial: Univariate Time Series Analysis Prof. Dr. Matei Demetrescu	5 ECTS summer	elective	l: 2 SWS (30 hrs.) t: 1 SWS (15 hrs.)
credit points and grade	5 ECTS		German Scale, ECTS-System	
workload entire module	150 hours			
language	English			
requirements for performance assessment	Written exam			
educational objectives / competencies	The aim of the course is to provide students with the theoretical basis for working with time series models. It starts with an overview of basic notions of time series analysis, and continues with the simple component model distinguishing between deterministic and random components. For the random components, we introduce linear models for the conditional mean (in particular ARMA) and justify them by the Wold decomposition theorem. Estimation and model selection is discussed in detail for the autoregressive process. We also examine briefly GARCH models for the conditional variance and integrated models for stochastically trending variables.			
knowledge transfer by lectures + tutorials	Interactive lecture and tutorial, lecture notes, literature studies, exercises			
Contents **References**	1. Time series vs.˜stochastic processes 2. The component model and trend filters 3. ARMA models 4. Forecasting • Brockwell, P.J. and R.A. Davis (2002), Introduction to Time Series and Forecasting, 2nd ed., Springer • Hamilton, J. (1994), Time Series Analysis, Princeton University Press • Lütkepohl, H. and M. Krätzig (2004), Applied Time Series Econometrics, Cambridge University Press • Brockwell, P. J. and R. A. Davis (1991), Time Series: Theory and Methods, 2nd ed., Springer			

6. Seminars

module name	**Seminar on Stochastics and Mathematical Finance (Seminar Stochastik und Finanzmathematik)**			
module number	MNF-math-sem_fma_msc			
term / duration	2 or 3 / 1 semester			
responsible person for this module	Prof. Dr. Jan Kallsen			
attribution to curriculum	degree programme	status		
	M.Sc. Mathematical Finance	Seminar in Mathematical Finance		
courses	title teachers	credits term	status	time of attendance
	seminar: Seminar Stochastik und Mathematical Finance Prof. Dr. Jan Kallsen	4 ECTS n.s.	elective	2 SWS (30 hrs.)
credit points and grade	4 ECTS		German Scale, ECTS-System	
workload entire module	150 hours			
language	English or German			
requirements for performance assessment	Active and regular participation Oral presentation at an advanced stage (90 min.)			
educational objectives / competencies	Acquisition of research and communication competencies by self-dependent elaboration and presentation of an advanced topic from mathematical finance based on mathematical research papers.			
knowledge transfer	presentations, literature studies			

module name	**Seminar on Computational Finance and Mathematical Finance (Seminar Numerik und Finanzmathematik)**			
module number	MNF-math-sem_cfi_msc			
term / duration	2 or 3 / 1 semester			
responsible person for this module	Prof. Dr. Jan Kallsen			
attribution to curriculum	degree programme	status		
	M.Sc. Mathematical Finance	Seminar in Mathematical Finance		
courses	title teachers	credits term	status	time of attendance
	seminar: Seminar on Computational Finance and Mathematical Finance Prof. Dr. Jan Kallsen	4 ECTS winter	elective	2 SWS (30 hrs.)
credit points and grade	4 ECTS		German Scale, ECTS-System	
workload entire module	150 hours			
language	English or German			
requirements for performance assessment	Active and regular participation Oral presentation at an advanced stage (90 min.)			
educational objectives / competencies	Acquisition of research and communication competencies by self-dependent elaboration and presentation of an advanced topic from mathematical finance based on mathematical research papers.			
knowledge transfer	Interactive lecture and tutorial, lecture notes, literature studies, exercises			

module name	**Research Seminar Mathematical Finance**			
module number	MNF-math-sem_fma_msc			
term / duration	4 / 1 semester			
responsible person for this module	Prof. Dr. Jan Kallsen			
attribution to curriculum	degree programme	status		
	M.Sc. Mathematical Finance	Research Seminar		
courses	title teachers	credits term	status	time of attendance
	seminar: Research Seminar Prof. Dr. Jan Kallsen	3 ECTS n.s.	elective	2 SWS (30 hrs.)
credit points and grade	3 ECTS		German Scale, ECTS-System	
workload entire module	90 hours			
language	English or German			
requirements for performance assessment	Active and regular participation Oral presentation at an advanced stage (90 min.)			
educational objectives / competencies	Acquisition of research and communication competencies by self-dependent elaboration and presentation of topics concerning the own master thesis			
knowledge transfer	presentations, literature studies			

7. Master Thesis

module name	**Master Thesis (Mathematical Finance)**			
module number	Not specified			
term / duration	4 / 1 semester			
responsible person for this module	Prof. Dr. Jan Kallsen			
attribution to curriculum	**degree programme**	**status**		
	M.Sc. Mathematical Finance	Master Thesis		
courses	**title** **teachers**	**credits** **term**	**status**	**time of attendance**
	Thesis:	26 ECTS	compulsory	none
credit points and grade	26 ECTS		German Scale, ECTS-System	
workload entire module	780 hours			
language	German or English			
requirements for performance assessment	Writing a Master Thesis, Oral presentation in the research seminar			
educational objectives / competencies	Acquisition of research and communication competencies by self-dependent elaboration and presentation of an advanced topic from mathematical finance based on mathematical research papers.			
knowledge transfer	Writing scientific texts, literature studies			

8. Internship

module name	**Internship**			
module number	MNF-math-sem_fma_msc			
term / duration	2 / 1 semester			
responsible person for this module	Prof. Dr. Jan Kallsen			
attribution to curriculum	degree programme	status		
	M.Sc. Mathematical Finance	Internship		
courses	title teachers	credits term	status	time of attendance
	seminar: Seminar Stochastik und Mathematical Finance Prof. Dr. Jan Kallsen	4 ECTS n.s.	compulsory	Not specified
credit points and grade	4 ECTS		German Scale, ECTS-System	
workload entire module	120 hours			
language	Not specified			
requirements for performance assessment	Report on the tasks during the internship (ungraded)			
educational objectives / competencies	Insights for possible applications of Mathematical Finance/ Mathematics in research, delelopment and economy			
knowledge transfer	Application and implementation of mathematical methods in professional practice			