



PhD plan

Preliminary PhD plan when applying for enrolment
Final PhD plan - provided within 3 months after enrolment
Adjusted PhD plan - for substantive changes

1. General information	
Name: Xie Xiaolei	Date of enrolment (dd/mm/yyyy): 01/10/2014
Civ. Reg. No. (CPR. Nr.):	E-mail: xie.xiaolei@gmail.com
Department: Mathematical Sciences, IMF	Place of employment (if different from department):
Title of project (working title): An empirical study of large financial data sets	
<input checked="" type="checkbox"/> 5+3 Scheme <input type="checkbox"/> 4+4 Scheme <input type="checkbox"/> Industrial PhD	
Principal supervisor (employed at the Faculty of Science)	Name: Thomas Mikosch
	Title: Professor
	Department: IMF
	E-mail: mikosch@math.ku.dk
Co-supervisor (if any)	Name: Rolf Poulsen, Jeffrey Collamore
	Title: Professor, Associate Professor
	Place of employment: IMF
	E-mail: rolf@math.ku.dk , collamore@math.ku.dk

2. Status
<input type="checkbox"/> This is a preliminary PhD plan (included when applying for enrolment) <input checked="" type="checkbox"/> This is the final PhD plan <input type="checkbox"/> This is an adjusted PhD plan <i>Please note that only major adjustments should lead to a revision of the PhD plan.</i>

2.1 Please give a brief summary of the adjustments

3. Description of the PhD project (e.g. objectives and hypotheses for the project, research plan and methods):

The general goal of this project is to study large financial data sets from different angles. This topic is related to modern statistical and econometric time series analysis, where the dimension of the data grows with the sample size, e.g. stock returns in a large portfolio over a period of a year say. Then natural questions are related to the meaning of standard estimators of covariance and their relevance. In this context, principal component analyses are useful. They are based on determining the largest eigenvalues of the sample covariance matrix and as well as on selecting the number of meaningful eigenvalues. The goal is dimension reduction and focusing on a smaller amount of stock which may replicate the whole portfolio. Theoretical work has been conducted by Lam and Yao (Ann. Statistics, 2012) in the context of multivariate regression models. The project will use this paper as a motivation for conducting similar analyses for time series models, extending the results to genuine serial dependence. Financial return series are often heavy-tailed. Davis, Mikosch and Pfaffel (2013) have written an article about the asymptotic behavior of the largest eigenvalues of sample covariance matrices of linear models with heavy tails. The project aims at making this theory work on large financial data sets. This is the part of the project which will be conducted jointly with principal supervisor.

Another part will be conducted in collaboration with Jeff Collamore who is a specialist on Markov chains, rare event simulation and large deviation problems. Various financial time series models such as the GARCH model have very complicated structure. For example, they have heavy-tailed finite-dimensional distributions. These distributions depend on constants which are rarely known explicitly such as the tail indices and scaling constants of the tails. In this context, it is important to have efficient simulation methods for determining these quantities for a given model. This part of the project aims at the efficient simulation for multivariate GARCH structures and related models as well of fitting these models to real data to derive tail estimates for the purposes of quantitative risk analyses.

4. Time table for the PhD project (indicate the most important milestones, e.g. a Gantt chart or a list of activities)

1st year:

- Reading relevant literature
- Taking basic courses in *quantitative risk management, extreme value theory*
- Preparation of 1st paper on sample covariance matrices of high-dimensional data
- Participating in the conference on *extreme value theory* in June, 2015

2nd year:

- Submission of 1st paper to journal
- Preparation of 2nd paper
- Participation in conference

3rd year:

- Submission of 2nd paper.
- Finalizing 3rd paper
- Writing thesis
- 3 months' visit to Erasmus university in Rotterdam.

5. Planned PhD courses

The list should contain an overview of planned courses for the coming 3 years. Changes to the list can be made during the PhD study in your progress assessment report.

Types of courses

1. Complementary skills courses, e.g. Introduction course, Introduction to University Pedagogy, scientific writing, dissemination of knowledge, project management.
2. International/specialist courses (min. 10 ECTS credits can be approved)
3. Advanced master's courses
4. In addition, a number of ECTS points may be awarded for participation in journal clubs, self-study etc.

The total number of ECTS should be approx. 30

Name of the course	Type (1-4)	Organised by (institution):	Date passed	ECTS
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Measure Theory	3	IMF	June, 2015	7.5
Quantitative Risk Management	3	IMF	January, 2015	7.5
Extreme Value Theory	3	IMF	January, 2015	7.5
Stochastic Integration	3	IMF	June, 2015	7.5
Introduction to University Pedagogy	1	IMF	January, 2016	2.5
Total number of ECTS				

6. Change of scientific environment.

Planned stays and visits to other academic research environments in Denmark and abroad.

Institution	Country	Period (dd/mm/yyyy)
Erasmus University, Rotterdam	The Netherlands	January – March, 2017

If the plan does not include a stay abroad, provide brief justification here:

7. Planned communication and teaching activities

Course name/activity	Contribution	Total number of hours
Statistics for non-life insurance	Teaching assistant	
Non-life Insurance Mathematics	Teaching assistant	
The student is self-financing and not required to teach.		

8. Agreement on intellectual property rights (e.g. patents)

(also see: Tech Transfer Unit at the University of Copenhagen <http://fi.ku.dk/english/>)

<input checked="checked" type="checkbox"/> Not relevant <input type="checkbox"/> The co-author agreement on intellectual property rights is attached

9. An agreement on the form and extent of supervision

Within fourteen days after admission, the principal supervisor and the PhD student must have discussed the form and extent of the supervision. The principal supervisor is committed to conduct regular meetings and take responsibility for the PhD student's academic progress. If there is more than one supervisor, their individual roles must be clarified.

Get inspiration from the supervision pamphlet: "- To lead the way". See direct link here:

http://www.ind.ku.dk/udvikling/projekter/phdvejledning/Final_KU_god_vejledning_UK_web.pdf/

Regular meetings between the supervisor and the PhD student.

10. Research school (FUP) affiliation (if any):

None

11. Project collaboration partners:

None

12. Budget: Is the budget for the PhD project in accordance with the information provided in the recommendation of admission?

The student supports himself financially.

To be filled in by the PhD coordinator or principal supervisor

The 3 most important subjects of the PhD project	Subject	Subject	Subject
Subject code (see list below)	120	125	525
Percentage share of total research time. (The sum must be 100%)	30	40	30
Subject codes: Natural sciences	Subject codes: Technical sciences		Subject codes: Medical sciences
120 Mathematics	220 Civil engineering, construction engineering and transport		320 Basic medicine
125 Computer and information sciences	225 Electrical and electronic engineering and communication engineering		325 Pharmacy and pharmacology

<i>130 Physical science, incl. biophysics</i>	<i>235 Chemical engineering</i>	<i>330 Clinical medicine</i>
<i>135 Chemical sciences</i>	<i>240 Materials engineering</i>	<i>340 Health services</i>
<i>140 Earth and related Environmental sciences, geology and geophysics</i>	<i>245 Medical engineering</i>	<i>360 Public health science</i>
<i>141 Physical geography</i>	<i>250 Energy and environment engineering</i>	<i>370 Medical biotechnology</i>
<i>142 Cultural geography</i>	<i>255 Environmental engineering</i>	<i>380 Other allied sciences</i>
<i>145 Biochemistry</i>	<i>260 Industrial biotechnology</i>	
<i>150 Biology</i>	<i>265 Nanotechnology</i>	
<i>155 Other allied sciences</i>	<i>270 Other allied sciences</i>	
Subject codes: Agricultural sciences	Subject codes: Social sciences	
<i>420 Agricultural plants and garden Centre</i>	<i>525 Economics</i>	
<i>425 Forestry and horticulture</i>	<i>530 Business management</i>	
<i>435 Animal and dairy production</i>	<i>545 Jurisprudence</i>	
<i>445 Agricultural biotechnology</i>	<i>550 Political science</i>	
<i>450 Other allied sciences</i>	<i>555 Town planning and physical planing</i>	
	<i>565 Other allied sciences</i>	

Research areas (Percentage of total research time)	1-24%	25-49%	50-74%	75-100%	No research
Climate (3)					
Energy (4)					
Environment (6)					
Bio-technology (14)					
Food products (including food safety) (8)					
Cancer (11)					
Nanotechnology (15)					
ICT hardware (18)					
ICT software (19)					
ICT usage (20)					
Integration (23)					
Democracy (25)					
Welfare (26)					
Gender research (31)					

Globalization (32)					
Experience economy (35)					
Prevention and health promotion (9)					
Other (34)				X	

Signatures

PhD student: _____ <i>Signature</i>	Date: _____ <i>(dd/mm/yyyy)</i>
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Principal supervisor: _____ <i>Signature</i>	Date: _____ <i>(dd/mm/yyyy)</i>
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PhD coordinator: : _____ <i>Signature</i>	Date: _____ <i>(dd/mm/yyyy)</i>
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Guidelines for the form

The PhD plan is prepared jointly by the PhD student and the principal supervisor.

Three types of PhD plan

- ❖ The preliminary PhD plan
Must be handed in along with the application for enrolment.
- ❖ The final PhD plan
Must be provided within 2 months after enrolment.
- ❖ Adjusted PhD plan
Use the adjusted PhD plan for substantive changes (e.g. major changes in the project description).

SIGNATURES

The handwritten signatures requested above are not necessary if the PhD student forwards a brief e-mail correspondence which documents that all parties have seen and approved the completed PhD plan.

WHERE TO SEND THE FORM

When completed, the form should be sent to the relevant department (PhD secretary), who on your behalf will forward it to the PhD School (PhD@science.ku.dk). To find your department's PhD secretary, please see: <http://www.science.ku.dk/english/research/phd/student/>