MASTER'S PROGRAM IN

QUANTITATIVE DECISION MAKING IN ECONOMICS & MANAGEMENT



HEADS OF THE PROGRAM



Prof. Dr. Stefan Irnich



Prof. Dr. Florian Hett



Dr. Constantin Weiser



Daniela Maier, M.Sc.

Prof. Dr. Thorsten Schank

LECTURERS INVOLVED



Prof. Dr. Franz Rothlauf



Prof. Dr. Christopher Koch



Prof. Dr. Reyn van Ewijk



Prof. Dr. Katja Kaufmann



Prof. Dr. Klaus Wälde



Prof. Dr. Andranik Tumasjan



Prof. Dr. Daniel Schunk



Prof. Dr. Olga Zlatkin-Troitschanskaia



Prof. Dr. Andrej Gill



Prof. Dr. Oliver Emrich

LECTURERS INVOLVED



Prof. Dr. Natascha Nisic (FB02)



Jun.-Prof. Dr. Panagiotis Bouros (FB08)



Prof. Dr. Stefan Bender (Bundesbank)



Prof. Dr. Susanne Singer (Uni-Medizin)



Dr. Kai Lorentz (Destatis)



Prof. Dr. Matthias Bäcker (FB03, Rechtswissenschaften)

THIS PROGRAM IS APPROPRIATE FOR YOU IF ...

- you have fun using computers to analyse data and to write up your own programs
- you are interested in strategic decision making based on empirical evidence regarding behavioral and microeconomic mechanisms
- you want to increase your toolkit of **formal methods** to make data-driven decisions

WHAT IS THE PROGRAM ABOUT?

- The program combines three domains:
 - **1.** Econometric methods
 - 2. Management science & business intelligence
 - **3.** Economic behavior & strategy
- Graduates will have profound knowledge in both...
 - **1.** Analysing data
 - 2. Solving decision problems in complex economic environments
- This meets an **increasing demand** on the labour market

EXAMPLES OF EMPLOYMENT POSSIBILITIES

Google Careers

Data Scientist, Ads Metrics

🏨 Google 🛛 🖓 In-office: Zürich Switzerland 🕦

- Master's degree in a quantitative discipline (e.g., Statistics, Operations Research, Bioinformatics, Economics, Computational Biology, Computer Science, Mathematics, Physics, Electrical Engineering, Industrial Engineering) or equivalent practical experience.
- Experience with statistical software (e.g., R, Python, MATLAB, pandas) and database languages (e.g., SQL)
- Experience with statistical data analysis such as multivariate analysis, stochastic models, sampling methods

Dassault Systemes Deutschland GmbH

Operations Research Scientist (m/f/d) DELMIA Quintiq

S DASSAULT

🔋 Düsseldorf 🖨 Feste Anstellung 🕔 Vollzeit 🛗 Erschienen: vor 3 Wochen

- Relevant background in algorithmic techniques in operations research and/or artificial intelligence (linear programming, genetic algorithms, heuristic search techniques, logic programming, etc.).
- Master's degree in Operations Research, Computer Science, Mathematics, Econometrics, Artificial Intelligence, or similar.
- Your strong analytical skills complement your nature to challenge boundaries and think outside the box

Ökonom, Volkswirt, Economist, Economic Consulting Frankfurt am Main/Berlin, Germany



Sie wollen Ihre soliden quantitativen Fähigkeiten und Ihr ökonomisches Verständnis auf konkrete Fragestellungen und Herausforderungen unserer Kunden anwenden. Die erfolgreiche Bewerber*in wird an allen Aspekten eines Kundenauftrags arbeiten, einschließlich der Erstellung von Angeboten, des Projektmanagements, der analytischen Arbeit und der Übermittlung der Ergebnisse an die Kunden. Wir suchen Kandidat*innen für verschiedene Bereiche, darunter Klimawandel, digitale Märkte, Bauwesen, Wohnungsbau, Analyse der wirtschaftlichen Auswirkungen von Politikmaßnahmen, Wirtschaftsmodellierung und Szenarioanalyse

- Erfahrung in der Durchführung ökonometrischer Analysen (wünschenswert)
- Gute Präsentations- und Schreibfähigkeiten
- Ausgezeichnete Kenntnisse in Microsoft Excel, Word und PowerPoint
- Programmierkenntnisse in Stata, Python oder R oder Bereitschaft, sich diese anzueignen

EXAMPLES OF EMPLOYMENT POSSIBILITIES

DAIMLER

Bosch Gruppe

excellent communication and documentation skills, experience in mentoring junior colleagues, proven expertise in time series forecasting as well as in at least one of the following fields: neural networks, generalized linear models, recommendation systems, statistics, latent variable models, clustering and anomaly detection, demonstrated experience in working with ML/DL frameworks (e.g. scikit-learn, Keras, TensorFlow, PyTorch, R's forecast package), publications at major conferences or journals are highly appreciated, proficiency in Python (especially in such libraries as Pandas, Numpy, Scipy, statsmodels)



Internship as a Data Scientist in the field of digital transformation

- Design and structuring of databases
- Data visualization with the help of dashboards using <u>PowerBI</u>
- Collaboration and development of predictive analytics (regression analysis, forecasting & machine learning) projects
- Degree in Computer Science, Business Informatics, Statistics, Mathematics, Economics (VWL), Business Administration (BWL), Industrial Engineering or a comparable course of study with existing quantitative affinity

KEY FACTS

- Program start: winter term 2022/23
- Application period: **01.04. 15.05**.
- 20 places for the first cohort
- Selection criteria: **GPA (50%)** and **entrance test (50%)**
- Begin only in the winter term possible
- Core modules in English
- Most elective modules in English, some in German
- Small groups, interactive teaching, hands-on learning

PROGRAM STRUCTURE

• Semester 1: Fundamentals

 \rightarrow Core modules

• Semester 2/3: Specialisation

 \rightarrow Academic skills

 \rightarrow 7 elective modules out of the three domains or from the free part

 \rightarrow 2 applied project seminars

• Semester 4: Research

 \rightarrow Master thesis and research colloquium

THE PROGRAM STRUCTURE IN DETAIL



1 st Semester: Fundamentals				
Mathematics/Statistics Programming Econometrics of Cross Section and Pane	Operations Research Economic Decision Making & Strategic Interaction Panel Data			
2 nd & 3 rd Semester: Specialisation				
Academic Skills, 2 Applied Project Seminars (offered every semester in every domain); 7 elective modules				
Econometrics	Management Science & Business Intelligence	Economic Behaviour & Strategy		
Microeconometrics A Microeconometrics B Time Series Computational Statistics Analysis of Micro Data Data Governance Official Stat. and Survey Methods Mehrebenen/Panelanalyse Informations-/Datenschutzrecht	Intelligent Information Systems Data Analytics Database Systems/Info. Systems Process Mining Standortplanung & Netzwerkdesign Transport Logistics I Transportl Logistics II Revenue Management	Advanced Digital Economics Behavioral & Experimental Econ. Behavioral Measurement Behavioral Theory Corporate Finance Theory Economics of Education Inequality and Social Mobility Survey Methods/Subj. Beliefs		
Free Part (Further modules in Management, Accounting and Finance, Epidemiology, Sociology)				
4 th Semester: Research				

Master Thesis

Master Colloquium

ADMISSION REQUIREMENTS

• English language skills

 \rightarrow B2 level

- Bachelor's degree
 - \rightarrow 18 ECTS in management/economics
 - \rightarrow 19 ECTS in mathematics/statistics/econometrics/quantitative empirical methods
- Entrance test

ENTRANCE TEST

• Test specifics:

 \rightarrow Electronic test

 \rightarrow 90 minutes

 \rightarrow Taking place on the campus of the University of Mainz

 \rightarrow <u>Next DATE</u>: June 20, 2022

• Focus of the test:

- \rightarrow Conceptual understanding
- \rightarrow Abstraction from specific notation
- "Sample Material" and references to textbooks available on the homepage

ENTRANCE TEST

Content:

- Analysis (differentiation, integration, optimization)
- Linear algebra (matrix notation, operations, system of linear equations)
- Stochastic/probability theory (random variables, convergence)
- Descriptive statistics
- Estimation/testing
- Multiple regression analysis
- Algorithms (control structures, "reading")
- Microeconomic foundations (supply/demand, costs/profits, utility/preferences, market models)
- Game theory

For the three samples below, a regression analysis is carried out to estimate the model $y_i = \beta_0 + \beta_1 x_i + \varepsilon_i$. Which sample leads to the smallest standard error for the estimate of β_1 (A, B or C)?



Run the following program with paper and pencil. Which value for b will be returned?

1
$$S \leftarrow 9$$

2 $b \leftarrow S$
3 $n \leftarrow 0$
4 while $n < 2$ do
5 $b \leftarrow \frac{1}{2}(b + S/b)$
6 $n \leftarrow n+1$
7 return b

Carry out the following matrix operations.

$$\begin{bmatrix} 1 & 2 & 3 \end{bmatrix} \times \begin{bmatrix} 4 \\ 5 \\ 6 \end{bmatrix} =$$

$$\begin{bmatrix} 1\\2\\3 \end{bmatrix} \times \begin{bmatrix} 4 & 5 & 6 \end{bmatrix} =$$

The diagram shows the indifference curves of an ordinary consumer in a two-product setup (x_1, x_2) and the budget constraint. Which product-bundle will the consumer choose (A,B,C or D)?



Simon and Laura want to go out for dinner. Simon prefers pasta, Laura prefers potatoes. Both would love to go out to eat together. There is no restaurant in your city that offers both pasta and potatoes. There is only a pasta house and a potato house. The table shows the payoffs (Simon / Laura).

		Laura	
		potatoes	pasta
Simon	potatoes	2/4	0/0
	pasta	1/1	4 / 2

- 1. If possible, determine the Nash equilibrium(s) in pure strategies.
- Assume that Simon can credibly commit to a decision in front of Laura. Now determine the Nash equilibrium by backward induction (Hint: map the new situation in a sequential game)

Consider the following function plot. Which plots (A-F) show the first and second derivative of the function?



DO YOU HAVE QUESTIONS? FEEL FREE TO CONTACT US

LINK TO OUR HOMEPAGE

EMAIL

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WE ARE LOOKING FORWARD TO YOUR APPLICATION!



LINKS USED IN THE PRESENTATION

Employment possibilities:

Data Scientist – Google

Data Scientist, Time Series Analysis & Forecasting (f/m/div.) – Bosch

Operations Research Scientist (m/f/d) - DELMIA Quintiq

Oxford Economics Jobbörse

Daimler: Daimler Jobbörse

