



# Double degree programmes in Econometrics and Mathematics/Stochastics & Financial Mathematics

Version: 2020-2021

Date document: February 19, 2020.

The Amsterdam School of Economics of the Faculty of Economics and Business and the Graduate School of Science the Faculty of Science offer two double master degree programmes to earn master degrees in:

- Econometrics and Mathematics
- Econometrics and Stochastics & Financial Mathematics (SFM)

These programmes are open to students of the MSc in Econometrics and the MSc in Mathematics/SFM of the University of Amsterdam with sufficient background in Econometrics and Mathematics. Interested students have to be admitted to both the MSc in Econometrics and the MSc in Mathematics or the MSc in Stochastics and Financial Mathematics (SFM) to be able to do one of the double degree programmes.

The MSc in Econometrics offers four different tracks:

- Complexity and Economic Behaviour (CEB)
- Data Science and Business Analytics (DS&BA)
- Financial Econometrics (FE)
- Econometrics (ECT).

## 1 Admission

### 1.1 Admission to the MSc in Econometrics

Students with a BSc in Mathematics<sup>1</sup> of the University of Amsterdam can be admitted to the MSc in Econometrics if they have completed the minor Econometrics. This 30 EC minor consists of following five courses:<sup>2</sup>

1. Econometrics 1 (Semester 2, period 1)
2. Mathematical Economics 1 (Semester 2, period 1)
3. Econometrics 2 (Semester 2, period 2)

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<sup>1</sup>Students of this bachelor meet the prerequisites of the minor Econometrics because Stochastiek 1 (6 EC, first year) and Stochastiek 2 (6 EC, second year) are compulsory within the curriculum of the BSc in Mathematics.

<sup>2</sup>Note that the 30 EC elective part of the BSc in Mathematics is scheduled across two years: 6 EC in year 2, semester 2 and 24 EC in year 3, semester 1. As a consequence, this combination of courses is not completely studyable and therefore requires additional effort from students. Students are advised to do Econometrics 1 in their year 2 and Mathematical Economics 1, Mathematical Economics 2, Econometrics 2 and Time Series Analysis in their year 3.

4. Time Series Analysis (Semester 2, period 2)
5. Recommended: Mathematical Economics 2 (Semester 2, period 1). Alternative: Empirical Project (Semester 2, period 3).<sup>3</sup>

## 1.2 Admission to the MSc in Mathematics or the MSc in Stochastics and Financial Mathematics

Students with a BSc in Econometrics of the University of Amsterdam can be admitted to the MSc in Mathematics or the MSc in Stochastics and Financial Mathematics if they have completed 30 EC on the following courses of the BSc in Mathematics:<sup>45</sup>

1. Compulsory: Analysis 4 (Semester 1, periods 2+3)
2. Compulsory: Topology (Semester 2, periods 1+2)
3. Compulsory: Measure Theory (Semester 1, periods 1+2)
4. Compulsory: Functional Analysis (Semester 2, periods 1+2)
5. Elective: choose one of the courses: Markov Chains (Semester 1, periods 1+2), Partial Differential Equations (Semester 2, periods 1+2) or Bayesian Statistics (Semester 2, periods 1+2).

In practice the courses Analysis 4 and Topology need to be done before doing Measure Theory and Functional Analysis.

## 2 The Double Degree programmes

The total scope of each of these double degree programmes is at least 150 credits. There are two combinations possible:

- Double degree Econometrics and Mathematics
- Double degree Econometrics and Stochastics & Financial Mathematics (SFM)

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<sup>3</sup>Mathematical Economics 2 is strongly recommended. However, to make the minor more studyable Empirical Project is allowed.

<sup>4</sup>The second year courses Analysis 4 (= Analyse 4) and Topology (=Topologie) are offered in Dutch. The other courses are third year courses and offered in English. The second year courses will be offered in English if non Dutch speaking students of the BSc in Econometrics want to do these courses.

<sup>5</sup>Note the elective part of the BSc in Econometrics is scheduled in Semester 1 of the third year. As a consequence, this combination of courses therefore requires additional effort from students.

## 2.1 Double degree Econometrics and Mathematics:

### 2.1.1 Curriculum:

MSc in Econometrics <sup>†</sup>	MSc in Mathematics <sup>†</sup>
<ul style="list-style-type: none"> <li>▶ Advanced Econometrics 1 (S1, P1+2, 5 EC)</li> <li>▶ Data Science Methods (S1, P1, 5 EC)</li> <li>▶ Theory of Markets (S1, P1, 5 EC)</li> <li>▶ 2 out the following 3 courses:               <ul style="list-style-type: none"> <li>■ Complexity and Behaviour (S1, P2, 5 EC)</li> <li>■ Asset Pricing (S1, P2, 5 EC)</li> <li>■ Machine Learning for Econometrics (S1, P2, 5 EC)</li> </ul> </li> <li>▶ Advanced Econometrics 2 (S1, P3, 5 EC)</li> <li>▶ Track specific courses: 15 EC for CEB, DS&amp;BA, ECT* 10 EC for FE**</li> </ul>	<ul style="list-style-type: none"> <li>▶ MSc seminar Stochastics (6 EC) or MSc seminar Analysis &amp; Dynamical Systems (6 EC)</li> <li>▶ Measure Theoretic Probability (8 EC)</li> <li>▶ 24 EC from restrictive list of Math courses***</li> <li>▶ 12 EC from list of specialized Math courses****</li> <li>▶ Math restricted-choice electives: ***** 19 EC for the tracks CEB, DS&amp;BA, and ECT or 24 EC for the track FE</li> </ul>
▶ 36 EC Master Project Econometrics and Mathematics*****	

† Because of overlap in content, it is under no circumstance allowed to take both the MSc Mathematics course Stochastic Integration (8 EC) and the MSc Econometrics course Stochastic Calculus (5 EC).

\* Recommended MSc Math courses for the MSc Econometrics tracks DS&BA and CEB are:

- DS&BA track: Machine Learning Theory (8 EC)
- CEB track: Stochastic Networks (6 EC)

\*\* For the track Financial Econometrics, the MSc Mathematics course Stochastic Integration is compulsory and gives an exemption for the MSc Econometrics course Stochastic Calculus in the track FE.

\*\*\* The restrictive list of Math courses consists of the following restricted-choice electives of the MSc Mathematics:

- Asymptotic Statistics (8 EC)
- Functional Analysis (8 EC)
- Machine Learning Theory (8 EC)
- Partial Differential Equations (8 EC)
- Portfolio Theory (6 EC)
- Simulation Methods in Statistics (6 EC)
- Stochastic Integration (8 EC)
- Stochastic Networks (6 EC)
- Stochastic Processes (8 EC)
- Stochastic Simulation (6 EC)

\*\*\*\* The list of specialized Math courses consists of the following restricted-choice electives of the MSc Mathematics:

- Complex Networks (8 EC)
- Data-driven Decision Making in Operations Research (6 EC)

- Parallel Algorithms (8 EC)
- Queues and Lévy Fluctuation Theory (6 EC)
- Uncertainty Quantification and Data Assimilation (6 EC)
- Wavelets (6 EC)

\*\*\*\*\* The students in the MSc Econometrics tracks CEB, DS&BA and ECT take at least 19 EC of restricted-choice electives from the MSc Mathematics, in addition to the 24 EC of courses from the restrictive list of Math courses and the 12 EC of courses from the list of advanced Math courses. Statistical Models is excluded from the restricted-choice electives. The students in the MSc Econometrics track FE takes at least 24 EC of restricted-choice electives from the MSc Mathematics, in addition to the 24 EC of courses from the restrictive list of Math courses and the 12 EC of courses from the list of advanced Math courses.

Statistical Models is excluded from the MSc Mathematics restricted-choice electives for the double degree students. The MSc Econometrics course Data Science Methods gives an exemption for Statistical Models. 9 EC of exemptions in the MSc Mathematics are given for free-choice elective courses.

\*\*\*\*\* The Master Project Econometrics and Mathematics (36 EC) replaces the Master Thesis Econometrics (15 EC) and the Master Project Mathematics (36 EC). It has both econometrics and mathematics content, and will be supervised by two staff members, one from each discipline.

### 2.1.2 Total credits:

The credit load of the combined MSc in Econometrics and MSc in Mathematics double degree curriculum consists of:

- 40 (MSc in Econometrics - track Financial Econometrics) or 45 EC (MSc in Econometrics - other tracks) in MSc in Econometrics except master project
- 74 EC (MSc in Econometrics - track Financial Econometrics) or 69 EC (MSc in Econometrics - other tracks) in MSc in Mathematics except master project
- 36 EC (master project Econometrics and Mathematics)

In total 150 EC.

## 2.2 Double degree Econometrics and Stochastics and Financial Mathematics:

### 2.2.1 Curriculum:

MSc in Econometrics <sup>†</sup>	MSc in Stochastics and Financial Math.
<ul style="list-style-type: none"> <li>▶ Advanced Econometrics 1 (S1, P1+2, 5 EC)</li> <li>▶ Data Science Methods (S1, P1, 5 EC)</li> <li>▶ Theory of Markets (S1, P1, 5 EC)</li> <li>▶ 2 out the following 3 courses:               <ul style="list-style-type: none"> <li>■ Complexity and Behaviour (S1, P2, 5 EC)</li> <li>■ Asset Pricing (S1, P2, 5 EC)</li> <li>■ Machine Learning for Ectrics (S1, P2, 5 EC)</li> </ul> </li> <li>▶ Advanced Econometrics 2 (S1, P3, 5 EC)</li> <li>▶ Track specific courses:               <ul style="list-style-type: none"> <li>15 EC for CEB, DS&amp;BA, ECT*</li> <li>10 EC for FE**</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>▶ Master seminar SFM (3 EC)</li> <li>▶ Measure Theoretic Probability (8 EC)</li> <li>▶ Stochastic Integration (8 EC)</li> <li>▶ 12 EC from Fin. Math. course list***</li> <li>▶ 20 EC from restrictive list of SFM courses****</li> <li>▶ SFM restricted-choice electives:*****               <ul style="list-style-type: none"> <li>18 EC for the tracks CEB, DS&amp;BA and ECT</li> <li>or 23 EC for the track FE</li> </ul> </li> </ul>
▶ 36 EC Master Project Econometrics and Stochastics & Financial Mathematics *****	

<sup>†</sup> Because of overlap in content, with the compulsory MSc SFM course Stochastic Integration it

is not allowed to take the MSc Econometrics course Stochastic Calculus (5 EC).

\* Recommended MSc Math courses for the MSc Econometrics tracks DS&BA and CEB are:

- DS&BA track: Machine Learning Theory (8 EC)
- CEB track: Stochastic Networks (6 EC)

\*\* The MSc Mathematics Stochastic Integration will give an exemption for Stochastic Calculus.

\*\*\* The list of Financial Mathematics courses consists of the following restricted-choice electives of the MSc Stochastics & Financial Mathematics:

- Computational Finance (6 EC)
- Interest Rate Models (6 EC)
- Portfolio Theory (6 EC)
- Stochastic Processes for Finance (6 EC)

\*\*\*\* The restrictive list of SFM courses consists of the following restricted-choice electives of the MSc Stochastics & Financial Mathematics:

- Asymptotic Statistics (8 EC)
- Data-driven Decision Making in Operations Research (6 EC)
- Machine Learning Theory (8 EC)
- Queues and Lévy Fluctuation Theory
- Simulation Methods in Statistics (96 EC)
- Stochastic Networks (8 EC)
- Stochastic Processes (8 EC)
- Stochastic Simulation (6 EC)

\*\*\*\*\* The students in the MSc Econometrics tracks CEB, DS&BA and ECT take at least 18 EC of restricted-choice electives from the MSc Mathematics, in addition to the 20 EC of courses from the restrictive list of SFM courses and the 12 EC of courses from the list of Financial Mathematics courses. The students in the MSc Econometrics track FE takes at least 23 EC of restricted-choice electives from the MSc Stochastics & Financial Mathematics, in addition to the 20 EC of courses from the restrictive list of SFM courses and the 12 EC of courses from the list of Financial Mathematics courses.

Statistical Models is excluded from the MSc SFM restricted-choice electives for the double degree students. The MSc Econometrics course Data Science Methods gives an exemption for Statistical Models. 9 EC of exemptions in the MSc SFM are given for free-choice elective courses.

\*\*\*\*\* The Master Project Econometrics and Stochastics & Financial Mathematics (36 EC) replaces the Master Thesis Econometrics (15 EC) and the Master Project Stochastics & Financial Mathematics (36 EC). It has both econometrics and SFM content, and will be supervised by two staff members, one from each discipline.

### **2.2.2 Total credits:**

The credit load of the combined MSc in Econometrics and MSc in Stochastics and Financial Mathematics double degree curriculum consists of:

- 40 (MSc in Econometrics - track Financial Econometrics) or 45 EC (MSc in Econometrics - other tracks) in MSc in Econometrics except master project
- 74 EC (MSc in Econometrics - track Financial Econometrics) or 69 EC (MSc in Econometrics - other tracks) in MSc in Stochastics and Financial Mathematics except master project
- 36 EC (master project Econometrics and Stochastics & Financial Mathematics)

In total 150 EC.

## **3 Important remarks:**

### **3.1 Be aware:**

1. Study programmes must be approved by both the Examination Boards of both the MSc in Econometrics and the MSc in Mathematics or the MSc in Stochastics and Financial Mathematics. These programmes must meet the standard requirements of the separate Master's programmes that make up the double degrees. The total number of credits needs to be at least 150 EC (not counting exemptions). With respect to the master project, this means that the master project (36 EC) will be on both diplomas.
2. This document describes the Double Degree programmes for students starting on September 1st 2019 or later. Students that started earlier need to comply with the former regulations as described in the TER/OER of the MSc in Econometrics and the MSc in Mathematics/MSc in Stochastics and Financial Mathematics.

### **3.2 Thesis**

The master thesis of the MSc in Econometrics and the MSc in Mathematics or the MSc in Stochastics and Financial Mathematics is a combined thesis project of 36 EC which will be acknowledged on the diploma of the MSc in Mathematics or the MSc in Stochastics and Financial Mathematics. On the diploma of the MSc in Econometrics the thesis will be exempted (15 EC) and it is indicated that a combined thesis has been written. For the judgement of cum laude the grade of the thesis as listed on the diploma of the MSc in Mathematics or the MSc in Stochastics and Financial Mathematics will be taken into account.

### **3.3 Further information**

- MSc in Econometrics: Dr J.C.M. van Ophem, programme director.
- MSc in Mathematics and the MSc in Stochastics & Financial Mathematics: Dr. J. Brandts, programme director.