

Assessment report  
Limited Framework Programme Assessment

**Master Mathematical Sciences**

Utrecht University

*Contents of the report*

1. Executive summary .....	2
2. Assessment process .....	4
3. Programme administrative information.....	7
4. Findings, considerations and assessments per standard .....	8
4.1 Standard 1: Intended learning outcomes .....	8
4.2 Standard 2: Teaching-learning environment .....	11
4.3 Standard 3: Student assessment.....	14
4.4 Standard 4: Achieved learning outcomes .....	16
5. Overview of assessments.....	17
6. Recommendations .....	18

## 1. Executive summary

In this executive summary, the panel presents the main considerations which led to the assessment of the quality of the Master Mathematical Sciences programme of Utrecht University. The programme was assessed according to the standards of the limited framework, as laid down in the NVAO Assessment framework for the higher education accreditation system of the Netherlands, published on 20 December 2016 (Staatscourant nr. 69458).

The panel appreciates the programme objectives to educate students broadly in the discipline of mathematics and in-depth in one of the specialisations offered. The panel welcomes the programme being strongly research-based. In addition, the panel is positive about students being taught to engage actively in research themselves.

The panel considers the Domain-Specific Framework of Reference to be an appropriate description of the mathematics discipline and of the standards and requirements graduates of both bachelor and master programme have to meet. The panel welcomes the efforts of the joint Mathematics programmes in the Netherland to have drafted this Framework. The objectives and intended learning outcomes of this programme meet the Framework and, therefore, correspond to international standards set for the discipline.

The panel supports the programme intentions to educate students for PhD positions as well as for positions in the non-academic professional field. The panel welcomes students being offered a wide range of programmes to choose from.

The intended learning outcomes of the programme correspond to the programme objectives, are comprehensive, stated in clear terms and are conform to the master level.

The entry requirements and the admission procedures of the programme are appropriate. The panel is positive about the pre-master programme, allowing students with deficiencies to enter the programme.

The curriculum of the programme matches the intended learning outcomes and is well-designed. The panel regards the curriculum to be solid, with strong courses. The panel especially appreciates the mandatory courses, which allow students to become acquainted with diverse, interesting dimensions of the discipline. The panel welcomes the research in the history of mathematics field benefiting the students. The curriculum coherence for individual students is ensured through the guidance by tutors in drafting the individual study plans. The research parts in the curriculum are of good quality. The Mastermath courses are enriching, offering a wide range of courses in various fields to students.

The staff in the programme are all PhDs and have strong research backgrounds. Their educational capabilities are up to standard. The staff is perceived by the panel to be a coherent team. The regular staff meetings on education are positive. Although the work load of the lecturers is within bounds, the panel welcomes extra staff being recruited.

The educational concept and study methods of the programme meet the programme's characteristics. The students-to-staff ratio allows for small-scale teaching. The panel is positive about the study guidance by the study advisor and the tutors. The panel considers the programme to be feasible, feasibility being promoted by the drafting of study plans. The panel suggests to take the position of the programme into account, when implementing University or Faculty measures. The panel notes that some of the Mastermath courses become more challenging. The panel advises to discuss this issue with Mastermath management. The facilities of the programme are up to standard. The panel suggests, however, to improve the video-recordings of Mastermath courses. The panel notes the programme has taken measures to monitor the student success rates, but advises to strengthen these measures further, as the student success rates remain somewhat disappointing.

The programme examination and assessment policies are in line with the Faculty and Graduate School rules and regulations. The panel is positive about the responsibilities and activities of the Board of Examiners and the Executive Panel for the Mathematics programmes, acting on behalf of the Board.

The examination methods selected in the courses are approved by the panel, as they meet the course contents. The panel appreciates the diversity in examination methods adopted in the courses.

The Master Research projects supervision and assessment are organised effectively and in a reliable way. The panel, however, advises to add more extensive arguments to substantiate the assessments of the Master theses.

The panel welcomes the measures taken by programme management to ensure the examinations and assessments quality. The panel approves of the regulations regarding the Mastermath examinations and the quality control of these examinations by the Board of Examiners.

The examinations of the courses are of more than adequate level. The panel supports the grades awarded to the Master theses. No theses were found to be unsatisfactory. The panel regards the theses to be very solid and sometimes excellent in terms of the scientific level. For the panel, the proportion of graduates having co-authored journal papers is the confirmation of the level achieved in the theses.

The panel is convinced that the programme graduates have reached the intended learning outcomes of the programme. The panel was pleased to see that programme graduates invariably find suitable positions shortly after graduation. The panel welcomes the high proportion of graduates having gained PhD positions.

The panel that conducted the assessment of the Master Mathematical Sciences programme of Utrecht University assesses this programme to meet the standards of the limited framework, as laid down in the NVAO Assessment framework for the higher education accreditation system of the Netherlands, judging the programme to be *satisfactory*. Therefore, the panel recommends NVAO to accredit this programme.

Rotterdam, 27 September 2019

Prof. dr. ir. O.J. Boxma  
(panel chair)

drs. W. Vercouteren  
(panel secretary)

## 2. Assessment process

The evaluation agency Certiked VBI received the request by Utrecht University to support the limited framework programme assessment process for the Master Mathematical Sciences programme of this University. The objective of the programme assessment process was to assess whether the programme conforms to the standards of the limited framework, as laid down in the NVAO Assessment framework for the higher education accreditation system of the Netherlands, published on 20 December 2016 (Staatscourant nr. 69458).

Management of the programmes in the assessment cluster WO Wiskunde convened to discuss the assessment panel composition and to draft the list of candidates. The panel composition for this assessment has been based upon these considerations.

Having conferred with Utrecht University programme management, Certiked invited candidate panel members to sit on the assessment panel. The panel members agreed to do so. The panel composition was as follows:

- Prof. dr. ir. O.J. Boxma, full professor Stochastic Operations Research, Eindhoven University of Technology (panel chair);
- Prof. dr. R.H. Kaenders, full professor Mathematics and its Education, University of Bonn, Germany (panel member);
- Prof. dr. D. van Straten, full professor Algebraic Geometry, Johannes Gutenberg University Mainz, Germany (panel member);
- Dr. ir. H.J. Prins, manager Research & Development, Maritime Research Institute the Netherlands (panel member);
- S.C. Jongerius BSc, student Master Industrial and Applied Mathematics, Eindhoven University of Technology (student member).

On behalf of Certiked, drs. W. Vercouteren served as the process coordinator and secretary in the assessment process.

All panel members and the secretary confirmed in writing being impartial with regard to the programme to be assessed and observing the rules of confidentiality. Having obtained the authorisation by the University, Certiked requested the approval of NVAO of the proposed panel to conduct the assessment. NVAO have given their approval.

To prepare the assessment process, the process coordinator convened with management of the programme to discuss the planning of the activities in preparation of the site visit. The site visit schedule was also discussed. In addition, the outline of the self-assessment report and the subjects to be addressed in this report were part of the discussion.

In the course of the process preparing for the site visit, programme management and the Certiked process coordinator had contact to fine-tune the process. The activities prior to the site visit have been performed as planned. Programme management approved the site visit schedule.

Well in advance of the site visit date, programme management sent the list of final projects of graduates of the programme of the most recent years. Acting on behalf of the assessment panel, the process coordinator selected the theses of fifteen graduates. The grade distribution in the selection was conform to the grade distribution in the list, sent by programme management. Specialisations of the programme were covered in the selection.

The panel chair and the panel members were sent in time the self-assessment report of the programme, including appendices. In the self-assessment report, the student chapter was included. In addition, the expert panel members were forwarded a number of theses of the programme graduates, these theses being part of the selection made by the process coordinator.

Before the site visit date, the assessment panel chair and the process coordinator met to discuss the self-assessment report to be provided by programme management, the procedures regarding the assessment process and the site visit schedule. In this meeting, the profile of panel chairs of NVAO was discussed as well. The panel chair was comprehensively informed about the competencies, listed in the profile.

Being informed by the process coordinator, all panel members sent in their preliminary findings, based on the self-assessment report and the final projects studied, and a number of questions to be put to the programme representatives on the day of the site visit. The panel secretary summarised this information, compiling a list of questions, which served as a starting point for the discussions with the programme representatives during the site visit.

Shortly before the site visit date, the panel met to go over the preliminary findings concerning the quality of the programme. During this meeting, the preliminary findings of the panel members, including those about the theses were discussed. The procedures to be adopted during the site visit, including the questions to be put to the programme representatives on the basis of the list compiled, were discussed as well.

On 29 April 2019, the panel conducted the site visit on the Utrecht University campus. The site visit schedule was as planned. In a number of separate sessions, the panel was given the opportunity to meet with Faculty Board representatives, programme management, Board of Examiners members, lecturers and final projects examiners, and students and alumni.

In a closed session near the end of the site visit, the panel considered every one of the findings, weighed the considerations and arrived at conclusions with regard to the quality of the programme. At the end of the site visit, the panel chair presented a broad outline of the considerations and conclusions to programme representatives.

Clearly separated from the process of the programme assessment, the assessment panel members and programme representatives met to conduct the development dialogue, with the objective to discuss future developments of the programme.

The assessment draft report was finalised by the secretary, having taken into account the findings and considerations of the panel. The draft report was sent to the panel members, who studied it and made a number of changes. Thereupon, the secretary edited the final report. This report was presented to programme management to be corrected for factual inaccuracies. Programme management were given two weeks to respond. Having been corrected for these factual inaccuracies, the Certiked bureau sent the report to the University Board to accompany their request for re-accreditation of this programme.

### 3. Programme administrative information

Name programme in CROHO: M Mathematical Sciences  
Orientation, level programme: Academic Master  
Grade: MSc  
Number of credits: 120 EC  
Specialisations: Algebraic Geometry and Number Theory  
Differential Geometry, Topology and Lie Theory  
Logic  
Differential Equations and Dynamical Systems  
Probability and Statistics  
Applied Mathematics, Complex Systems, and Scientific Computing  
Location: Utrecht  
Mode of study: Full-time  
Language of instruction: English  
Registration in CROHO: 21PD-60703  
Name of institution: Utrecht University  
Status of institution: Legal Entity for Higher Education  
Institution's quality assurance: Approved

## 4. Findings, considerations and assessments per standard

### 4.1 Standard 1: Intended learning outcomes

The intended learning outcomes tie in with the level and orientation of the programme; they are geared to the expectations of the professional field, the discipline, and international requirements.

#### *Findings*

The Master Mathematical Sciences programme is one of the master programmes of the Faculty of Science of Utrecht University. Within the Faculty, the programme is part of the Graduate School of Natural Sciences. The Board of Studies of the School has the responsibility for the organisation and the quality of this and the other Master programmes of the School. The Education Council, consisting of students and lecturers, evaluates the programme quality and advises the Board of Studies. The programme director of the Master Mathematical Sciences programme, assisted by the programme coordinator, takes care of the organisation of the programme. The lecturers involved in the programme, are members of the Mathematical Institute. Since 2018, the Curriculum Committee advises the programme director on the structure and the contents of the programme. The Education Advisory Committee, consisting of lecturers and students, councils the programme director on the programme quality. The Board of Examiners of the Graduate School of Natural Sciences has the authority to monitor the quality of the examinations and assessments of this programme. On behalf of the Board, the Executive Panel for the Mathematics programmes (kamer Wiskunde) monitors the quality of the examinations and assessments of the programme. The Board of Admissions of the School is responsible for the admission of candidate students.

The objectives of the programme are to educate students broadly and in-depth in the mathematics discipline, offering a wide range of specialisations and programmes. Students are trained broadly in the field of mathematics and are trained in-depth in one of the specialised fields offered. The specialisations offered are Algebraic Geometry and Number Theory; Differential Geometry, Topology and Lie Theory; Logic, Differential Equations and Dynamical Systems; Probability and Statistics; and Applied Mathematics, Complex Systems, and Scientific Computing. The programme is strongly research-based, being founded on the research done at the Mathematical Institute. This research is especially pronounced in the field of geometry, complex systems, and mathematical modelling. Research is also strong in the field of history of mathematics. In the programme, students are trained to do research in the field they specialise in. The specialisation Applied Mathematics, Complex Systems and Scientific Computing is in particular offered to accommodate students, interested in applied mathematics.

The joint Mathematics programmes in the Netherlands drafted the Domain-Specific Framework of Reference for both Bachelor and Master Mathematics programmes. In this Domain-Specific Framework of Reference, the generic objectives and the generic intended learning outcomes for these programmes have been listed. These objectives and intended learning outcomes meet the international standard for mathematics of ASIIN in Germany. They also correspond to the Dublin descriptors and the Meijers' criteria. In addition, they are largely comparable to those of the Mathematics programmes of renowned universities abroad, such as ETH Zürich, KU Leuven, and University of Padova.



Students are educated both for positions as PhD students or to work at academic master level outside of academia. A number of distinct programmes are offered. The standard programme (120 EC) offers six specialisations. Within the programme, students may opt for the profiles Complex Systems, Applied Data Science or Education, implying 30 EC of courses in these fields. When taking the Education profile, students choose to become fully-qualified teachers in Mathematics in Dutch secondary education or higher vocational education. Students may also take Double Master Programmes (180 EC), combining Mathematics with Theoretical Physics, Computing Science, History and Philosophy of Science or other disciplines. The Utrecht Geometry Centre Honours Programme (127.5 EC) prepares students for research careers in geometry. Students may add university-wide honours programmes to the standard programme.

The objectives of the programme have been translated into the intended learning outcomes for the programme. These include, as main elements, theoretical and practical understanding of advanced general concepts, principles and techniques of fundamental and/or applied mathematics, in-depth knowledge of at least one of the areas within the discipline, knowledge and skills to identify, analyse and formulate solutions to problems in mathematical sciences, research skills in this discipline, knowing how to evaluate research in the discipline, knowledge of integrity issues in scientific research, communication and collaborative skills, and competencies to enrol in PhD programmes or to work as mathematicians in the professional field.

Programme management compared the intended learning outcomes of the programme to the Dublin descriptors for master programmes, from which the correspondence of the intended learning outcomes to these Dublin descriptors may be inferred.

#### *Considerations*

The panel appreciates the programme objectives to educate students broadly in the discipline of mathematics and in-depth in one of the specialisations offered. The panel notes these specialisations to be wide-ranged. The panel appreciates the programme to be strongly research-based. In addition, the panel is positive about students being taught to do research themselves.

The panel considers the Domain-Specific Framework of Reference to be an appropriate description of the mathematics discipline and of the standards and requirements graduates of both bachelor and master programme have to meet. The panel welcomes the efforts of the joint Mathematics programmes in the Netherland to have drafted this Framework. The objectives and intended learning outcomes of this programme meet the Framework and, therefore, correspond to international standards set for the discipline.

The panel supports the programme intentions to educate students for PhD positions as well as for positions in the non-academic professional field. The panel welcomes students being offered a wide range of programmes they may be admitted to.

The intended learning outcomes of the programme correspond to the programme objectives. These intended learning outcomes are comprehensive, stated in clear terms and are conform to the master level.

*Assessment of this standard*

These considerations have led the assessment panel to assess standard 1, Intended learning outcomes, to be satisfactory.

## 4.2 Standard 2: Teaching-learning environment

The curriculum, the teaching-learning environment and the quality of the teaching staff enable the incoming students to achieve the intended learning outcomes.

### *Findings*

The number of students entering the programme was 48 students in 2016 and 34 students in 2017. The influx numbers remained rather stable the last six years. The backgrounds of students enrolling are quite diverse. They definitely are not only students having taken the Utrecht University Bachelor Mathematics programme. Students may commence in either September or in February. The entry requirements are the Bachelor Mathematics degree or Bachelor degrees with a major in mathematics of at least 75 EC from Dutch universities, having completed the programme within five years. Other students have to meet similar requirements. All students are to submit a letter of motivation. Foreign students also have to send in two reference letters and give proof of proficiency in English. On behalf of the Graduate School Board of Admissions, the programme director and the programme coordinator review all applications. Students not meeting the entry requirements, may be directed to the tailor-made pre-master programme, comprising 30 EC of courses at Bachelor level.

The study load of the curriculum is 120 EC. The curriculum takes two years to complete. Programme management presented a table, showing the curriculum to cover all of the intended learning outcomes. The curriculum of the standard programme is composed of mandatory courses (15 EC), primary electives (45 EC), secondary electives (15 EC) and the Research project (45 EC). Students choosing one of the profiles substitute the two latter components for profile courses (30 EC) and the Research project (30 EC). Students opting for Double Master programmes select for the latter part electives for their second Master (60 EC) and do the Research project (60 EC). The mandatory courses comprise the courses *Master Introduction; Orientation on Mathematical Research*, introducing students to research in the discipline; *Mathematics for Industry*, allowing students to work in groups on real-life problems, proposed by organisations; *Mathematical Colloquium*, requiring students to attend and report on at least four colloquia by international guest speakers; *Dilemmas of the Scientist*, addressing ethics in academic research; and *Seminars* on topics covering all six specialisations, in which students have to prepare and deliver seminar lectures, create hand-outs and grade hand-in exercises. Students are obliged to take at least one Seminar. As electives, the programme offers a number of local courses. Students may also take Mastermath courses. Mastermath is the joint organisation of the Master Mathematics programmes of all nine universities in the Netherlands. The Mastermath organisation offers courses for students of these universities. The Mastermath Board (Regieorgaan), consisting of all programme directors of the participating universities, selects the courses to be offered, chooses the lecturers lecturing in these courses and takes care of the quality control of the courses. For this programme, students take the more generic courses offered by Mastermath. The programme itself offers more specialised courses. For all Mastermath courses, quality control surveys among students are conducted. Two times per year, these surveys and the responses of Mastermath to the outcomes are discussed by Programme Committee representatives, among which Education Advisory Committee representatives for this programme. The Research project may be conducted in industry. The programme introduces new subjects in the curriculum. As has been indicated, the subject of data science is addressed in the Applied Data Science profile. This subject will be strengthened within the specialisation Applied Mathematics, Complex Systems and Scientific Computing.

The permanent staff lecturing in this programme and the Bachelor Mathematics programme are 28 lecturers. In addition, PhD students, postdocs and guest lecturers from industry are involved in the programme. Practically all permanent staff members are active researchers in the Mathematical Institute, all of them having PhD degrees. About 86 % of the staff members are BKO-certified and the remaining 14 % of them are in the process of obtaining this certificate. About 50 % of the lecturers are SKO-certified. Lecturers meet to discuss the programme and to adjust courses. Regular formal meetings of lecturers are scheduled. Informal lunch meetings take place as well. The lecturers with whom the panel met, expressed experiencing the work load to be high but manageable. The sector plan Mathematics will allow the programme to recruit extra staff. The programme intends to attract modelling experts as lecturers to strengthen this subject in the curriculum.

The educational concept of the programme is to train students to master ever more advanced mathematics and to proceed to self-directed learning in the discipline. Students are also trained in academic skills, to prepare them for their future positions. In addition, students are educated to do research in this field, culminating in the Research project. The students-to-staff ratio is 4.6/1. This ratio points to small-scale education. Study methods adopted are lectures and tutorials. In a number of mandatory courses, students work together in small groups on assignments and report orally and in writing on the results. The mandatory courses are meant to reinforce the community building among students in the programme. Students are to express their choice for one of the specialisations at the start of the programme. They are guided by tutors in drafting their study plans and for content-related study problems. Tutors and students meet every semester. The study plans are also the means to balance the study load. For study-related issues and problems, students may turn to the study advisor, who also monitors the study pace of the students. In case of study delay, students are invited for an interview. The course *Mathematics for Industry* acquaints students with the professional field. Extra-curricular career events are scheduled by the Graduate School and the study association to inform students about the labour market. In the Wiskundeoverleg (WOL), students are active in programme quality control. The average student success rates are 16 % after two years and 59 % after three years (figures for the last five cohorts).

### *Considerations*

The panel approves of the entry requirements and the admission procedures of the programme. The panel is also positive about the pre-master programme, allowing students with deficiencies to enter the programme.

The curriculum of the programme matches the intended learning outcomes and is well-designed. The panel regards the curriculum to be solid, with strong courses. The panel especially appreciates the mandatory courses, which allow students to become acquainted with diverse, interesting dimensions of the discipline. The curriculum coherence for individual students is ensured through the guidance by tutors in drafting the individual study plans. The research parts in the curriculum are of good quality. The Mastermath courses are enriching, offering a wide range of courses in various fields to students. The panel appreciates the research in the history of mathematics field benefiting the programme and allowing students to study and to graduate in this field.

The staff in the programme are all PhDs and have strong research backgrounds. Their educational capabilities are up to standard, as the substantial proportions of lecturers being BKO-certified or SKO-certified show. The staff is perceived by the panel to be a coherent team. The regular staff meetings on education are positive. Although the work load of the lecturers is within bounds, the panel welcomes extra staff being recruited.

The educational concept and study methods of the programme meet the programme's characteristics. The students-to-staff ratio is generous, allowing for small-scale teaching. The panel is positive about the study guidance by the study advisor and the tutors. The panel considers the programme to be feasible, feasibility being promoted by the drafting of study plans. The panel suggests to take the position of the programme into account, when implementing University or Faculty measures. The panel notes that some of the Mastermath courses become more challenging. The panel advises the programme to discuss this issue with Mastermath management. The facilities of the programme are up to standard. The panel suggests, however, to improve the video-recordings of the Mastermath courses. The panel notes the programme has taken measures to monitor the student success rates, but advises to strengthen these measures further, as the student success rates remain somewhat disappointing.

*Assessment of this standard*

These considerations have led the assessment panel to assess standard 2, Teaching-learning environment, to be satisfactory.

### 4.3 Standard 3: Student assessment

The programme has an adequate system of student assessment in place.
--

#### *Findings*

The programme policies regarding examinations and assessments are in line with the Graduate School of Natural Sciences assessment plan, meeting Faculty of Science examination policies. The Board of Examiners of the Graduate School of Natural Sciences has the authority to monitor examinations and assessments in this programme. The Executive Panel for the Mathematics programmes of the Board oversees the examinations and assessments of this programme.

The examination methods in the programme include written examinations, homework assignments, group assignments, reports, presentations, and, in some instances, oral examinations. The examination methods are aligned with the course goals. In most courses, multiple examination methods are scheduled. The final grade of the courses is the weighted outcome of the grades of these examinations.

Students select the topic for their Master Research project in cooperation with their supervisor. Research projects may be part of internships, done at external organisations. Students are to obtain the approval for the Research project, to ensure scientific quality. Before the start of the project, the details of the projects are laid down in the application form. The Research project is split in two phases, the Proposal (15 EC or 10 EC in case of a profile) and the Thesis (20, 30 or 45 EC, depending on the type of programme). Students are entitled to individual supervision either by their supervisor or by the daily supervisor. At the end of the Proposal phase, students submit their thesis proposal, comprising the topic, literature search and research questions. The Proposal is assessed by the supervisor and the second supervisor, sometimes with the advice of the daily supervisor. The Master Thesis is assessed by the supervisor acting as the first examiner, and the second examiner, the latter not having been involved in the project. The components to be assessed are process (30 % of the grade), results (25 %), thesis (25 %) and oral defence (20 %). The second examiner does not grade the process part. The Theses are assessed by the examiners, using assessment forms and rubrics forms.

In the programme, a number of measures have been taken to ensure the quality of examinations and assessments. The assessment plan for the programme has been drafted, aligning the intended learning outcomes of the programme, course objectives and course examinations. Examiners are appointed by the Board of Examiners, they being required to be BKO- or SKO-certified. The final examinations of the courses are peer-reviewed. On behalf of the Board of Examiners, the Assessment Committee reviews yearly examinations of randomly chosen courses as well as the assessments of Research projects. Procedures to prevent fraud and plagiarism and to signal and address cases are in place. Such cases are very rare.

The Board of Examiners monitors the contents of the Mastermath courses and of the examinations of these courses. The Assessment Committee monitors the quality of the examinations. Mastermath presents the course records, examination reports and the names of the examiners for the courses to the examination boards of the participating universities. These boards verify the quality of the courses and of the examinations. If one board approves of the quality, the other boards accept this decision as their own. The examination boards of all of the programmes, participating in Mastermath, meet yearly to discuss the Mastermath examinations' and assessments' quality assurance. The Teaching and Examination Regulations of this programme apply for the Mastermath courses.

### *Considerations*

The panel observed the programme examination and assessment policies to be in line with the Faculty and Graduate School rules and regulations. The panel is positive about the responsibilities and activities of the Board of Examiners and the Executive Panel for the Mathematics programmes, acting on behalf of the Board.

The examination methods selected in the courses are approved by the panel, as they meet the course contents. The panel appreciates the diversity in examination methods adopted in the courses.

The Master Research projects supervision is organised effectively. The assessment of these projects is conducted reliably. The panel, however, advises to add more extensive arguments to substantiate the assessments of the Master theses. These may take the form of concise comments on the selection of the topic of the thesis, the preparation of the student on the subject concerned, the summary of the contents of the thesis, the specification of the own contributions by the student, the creativity and mathematical depth of the student contributions, and the quality of writing and oral presentation by the student.

The panel welcomes the measures taken by programme management to ensure the examinations and assessments quality. The panel is positive about the regular reviews of examinations and theses by the Assessment Committee. The panel approves of the regulations regarding the Mastermath examinations and the quality control of these examinations by the Board of Examiners.

### *Assessment of this standard*

The considerations have led the assessment panel to assess standard 3, Student assessment, to be satisfactory.

#### 4.4 Standard 4: Achieved learning outcomes

The programme demonstrates that the intended learning outcomes are achieved.
--

##### *Findings*

The panel studied the examinations of a number of courses of the programme.

The panel also reviewed the Master theses of fifteen graduates of the programme with different grades. The proportion of students graduating cum laude, amounts to 44 % of the total number of graduates of the last five years. The cum laude threshold has been raised from 8.0 to 8.5, as the cum laude proportion was regarded to be too high. About 15 % of the Master theses lead to publications (22 publications out of 147 graduates for the last five years).

Programme management meets with alumni yearly. Alumni state that they were well prepared by the programme for their current positions. Representatives of the professional field are quite content about the graduates of the programme. The programme conducted a survey among alumni of the last years. The results of the survey show that about 80 % of the graduates have found positions immediately after the graduation and about 90 % of them have been employed within six months after graduation. About 43 % of the graduates secured PhD positions, 31 % in mathematics and 12 % in other disciplines. Other graduates found employment in the professional field, mostly in ICT (14 %), the financial sector (8 %), consultancy (7 %) or data science (5 %).

##### *Considerations*

The examinations of the courses which were reviewed by panel members are of more than adequate level.

The panel supports the grades awarded to the Master theses, recognising the high grades of the theses to be justified. No theses were found to be unsatisfactory. The panel regards the theses to be very solid and sometimes excellent in terms of the scientific level. For the panel, the proportion of graduates having co-authored journal papers is the confirmation of the level achieved in the theses.

The panel is convinced that the programme graduates have reached the intended learning outcomes of the programme. The panel was pleased to see that programme graduates invariably find suitable positions shortly after graduation. The panel welcomes the high proportion of graduates having gained PhD positions.

##### *Assessment of this standard*

The considerations have led the assessment panel to assess standard 4, Achieved learning outcomes, to be good.



## 5. Overview of assessments

Standard	Assessment
Standard 1. Intended learning outcomes	Satisfactory
Standard 2: Teaching-learning environment	Satisfactory
Standard 3: Student assessment	Satisfactory
Standard 4: Achieved learning outcomes	Good
Programme	Satisfactory

## 6. Recommendations

In this report, a number of recommendations by the panel have been listed. For the sake of clarity, these have been brought together below.

- To take the position of the programme into account, when implementing University or Faculty measures.
- To discuss with Mastermath management some Mastermath courses becoming more and more challenging.
- To improve the video-recordings of the Mastermath courses.
- To strengthen the measures already taken by the programme to monitor the student success rates, as these student success rates remain somewhat disappointing.
- To add more extensive comments and arguments to substantiate the assessments of the Master theses.