

Assessment report
Limited Framework Programme Assessment

Bachelor Mathematics

Vrije Universiteit Amsterdam

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 Bachelor Mathematics programme of Vrije Universiteit Amsterdam. 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 mathematics discipline, to acquaint them with foundations and applications of mathematics and to teach them research skills and academic skills.

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 Netherlands 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 programme intentions to educate students to continue their studies at master level are supported by the panel. The panel welcomes students being educated to enrol in master programmes in mathematics, but also in master programmes in other disciplines. The panel approves of the education minor being offered to allow students to become mathematics teachers in secondary education.

The intended learning outcomes of the programme correspond to the programme objectives, are comprehensive and are conform to the bachelor level.

The panel considers the influx of students to be limited, but is pleased to see the number of incoming students rising in the last few years. The panel approves of the admission requirements and entry procedures of the programme. Students are adequately informed about the challenging nature of the programme. In the first year, students are appropriately taught to study mathematics.

The curriculum of the programme matches the intended learning outcomes. The panel regards the curriculum to be appropriate, students being taught the fundamentals of the various fields within mathematics. As the number of majors and tracks offered in the curriculum is quite extensive and may be regarded to be somewhat confusing, the panel advises to reconsider the curriculum design, addressing both the tracks to be offered and the balance of fundamental and applied mathematics. As students in the applied mathematics major at present can avoid complex analysis, the panel proposes to make courses on this subject compulsory. In the panel's view, numerical methods should be addressed more coherently and more in-depth. The History of Science and Ethics courses are appreciated by the panel. The panel suggests to make the curriculum committee permanent.

The staff members lecturing in the programme have solid research backgrounds and are motivated teachers. Their educational capabilities are up to standard. The panel is positive about the role of junior lecturers in assisting students in the first year. The panel notes the appreciation of lecturers by

students. As the work load of lecturers is rather challenging, the panel welcomes extra staff being recruited.

The educational concept and the study methods adopted in the programme are effective. The panel is positive about groups of no more than three students taking practical classes in modelling. The panel applauds the intensive and effective study guidance by the academic advisor. The panel suggests to schedule the moment to select one of the tracks later in the curriculum. The material facilities are adequate, in particular after the relocation to the new building. As the drop-out rates and the student success rates are rather disappointing, the panel advises to monitor these and to hold exit interviews on the reasons for students to leave.

The examinations and assessment rules and regulations of the programme are in line with Vrije Universiteit Amsterdam and Faculty of Science policies. The panel is positive about the position and the activities of the Examination board. The panel considers the measures taken by the programme to assure the quality of examinations and assessments to be appropriate.

The panel approves of the examination methods adopted by the programme. The examination methods are consistent with the goals of the courses. The processes of marking examinations are adequate. The policies to curtail the effects of free-riding are appropriate.

The supervision and assessment processes for Bachelor projects have been well-organised. Students are offered appropriate supervision. The assessment procedures are up to standard, involving three examiners. The panel, however, advises to add more extensive arguments to substantiate the assessments of the Bachelor projects.

The examinations of the courses in the curriculum are of appropriate level. The panel assesses the Bachelor projects to be up to standard. The quality of the projects varies. The panel supports the grades awarded to the projects. No Bachelor projects were found to be unsatisfactory.

The panel is convinced the programme graduates have reached the intended learning outcomes of the programme. Programme graduates have access to quite a large number of master programmes. As the proportion of students proceeding from this programme to the Master Mathematics programme is quite limited, the panel advises to analyse these figures.

The panel that conducted the assessment of the Bachelor Mathematics programme of Vrije Universiteit Amsterdam 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, 30 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 Vrije Universiteit Amsterdam to support the limited framework programme assessment process for the Bachelor Mathematics 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 Vrije Universiteit Amsterdam 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.R. den Breeijen MSc, recently graduated student Master Mathematics, Radboud University Nijmegen (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 final projects of fifteen graduates from these years. The grade distribution in the selection was conform to the grade distribution in the list, sent by programme management. The study modes 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 17 June 2019 and 21 June 2019, the panel conducted the site visit on the Vrije Universiteit Amsterdam 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, Examination board members, lecturers and final projects examiners, students, and alumni and professional field representatives.

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: B Mathematics
Orientation, level programme: Academic Bachelor
Grade: BSc
Number of credits: 180 EC
Specialisations: None
Location: Amsterdam
Mode of study: Full-time, part-time
Language of instruction: English
Registration in CROHO: 21PL-59322

Name of institution: Vrije Universiteit Amsterdam
Status of institution: Government-funded
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 Bachelor Mathematics programme is one of the bachelor programmes of the Faculty of Science of Vrije Universiteit Amsterdam. The dean of the Faculty has the responsibility for all programmes of the Faculty. This bachelor programme is part of the Bachelor College of Natural Sciences and Mathematics of this Faculty. The director of the programme is responsible for the contents, the organisation and the quality of the programme. The programme director is assisted by the programme coordinator and the academic advisor. The Programme committee for the Bachelor Mathematics, Master Mathematics and Master Stochastics and Financial Mathematics programmes, being composed of equal numbers of lecturers and students, advises programme management on quality issues. The Faculty-wide Examination board assures the quality of examinations and assessments of this programme. The sub-committee of this Faculty-wide board for the Mathematics and Business Analytics programmes has the responsibility to assure the quality of examinations and assessments of this programme. A number of courses in the curriculum are offered by University of Amsterdam. The programme director meets regularly with University of Amsterdam representatives to coordinate these processes and to assure courses' quality.

The objectives of the programme are to educate students broadly in the mathematics discipline, to acquaint them with applications of mathematics in a number of fields, and to train them in academic and research skills. Students are introduced to the theory and practice of the classical fields within the mathematics discipline. They are also introduced to mathematical modelling, allowing them to apply mathematical theory and practice in various domains. In addition, students are trained in academic writing, oral presentations and doing research.

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, Cambridge University and University of Padova.

Students are offered majors to tailor the curriculum to their preferences. Students having begun the programme in 2017/2018 or in the years before, were offered the majors mathematics or biomedical mathematics. From the year 2018/2019 onwards, students may take the majors pure mathematics or applied mathematics. Within the major pure mathematics, students may select one of the tracks Algebra and geometry, Analysis and dynamical systems or Probability and statistics. Within the major applied mathematics, students may opt for one of the tracks Biomedical science, Computer science,

Data science or Econometrics. The majors and tracks are no formal specialisations, but packages of elective courses. The tracks mirror research interests of the Department of Mathematics and research interests of departments with which the Department maintains research relations. The differences between the programmes up to 2017/2018 and from 2018/2019 onwards are not fundamental. No double programmes are offered at the moment. The programme is considering a double programme in collaboration with the Department of Computer Science. In all tracks, students may take the Education minor allowing them to become grade-two qualified teachers in mathematics in Dutch secondary education.

From 2018/2019 onwards, the programme is offered in English. This step was taken to allow foreign students to enrol, to create an international classroom and to prepare students for the international labour market.

Students are not educated to directly enter the labour market, although some students may do so. Students are prepared to continue their education at master level in the mathematics discipline, but also in disciplines as physics, computer science, econometrics or operational research.

The objectives of the programme have been translated into intended learning outcomes. These include, as main elements, knowledge and understanding of the main fields within the mathematics discipline; awareness of the role and applicability of mathematics in other sciences and in society; knowing how to select and apply mathematical or computational techniques to solve (applied) mathematical problems; being capable of rigorously logical reasoning as is characteristic for mathematics; critical and independent judgment; communication skills; and to meet the entry requirements for mathematics programmes at master level.

The intended learning outcomes of the programme have been compared to the Dublin descriptors for bachelor programmes, to establish their bachelor level.

Considerations

The panel appreciates the programme objectives to educate students broadly in the mathematics discipline, to acquaint them with the foundations and applications of mathematics and to teach them research skills and general academic skills. The panel considers the programme objectives to be sound, introducing students appropriately to the mathematics discipline.

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 Netherlands 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 programme intentions to educate students to continue their studies at master level are supported by the panel. The panel welcomes students being educated to enrol in master programmes in mathematics, but also in master programmes in other disciplines. The panel approves of the Education minor being offered to allow students to become mathematics teachers in secondary education.

The intended learning outcomes of the programme correspond to the programme objectives. These intended learning outcomes are comprehensive and are conform to the bachelor 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 increased from 36 students in 2013 to 58 students in 2018. The number of students is expected to rise to about 80 students in 2019. The influx of Dutch students increases slightly. The main source for the increase comes from rising numbers of foreign students. In 2019, the proportions of Dutch students and foreign students will be more or less equal. About 25 % of the incoming students are part-time students, combining the study with their work or with other programmes. The entry requirements are the Dutch secondary school diploma, including the Mathematics B certificate. The entry requirements for foreign students are equivalent. On information days, the programme informs prospective students about the challenging nature of the curriculum. All students have to attend matching days either in person or on-line to reflect upon their decision to enter this programme. Students having entered the programme are to take calculus tests. In case of disappointing results, they are offered remedial classes. In study sessions as part of first year courses, students are taught how to study mathematics and are informed about time management, managing study progress, academic integrity and study and career options.

The study load of the curriculum is 180 EC. The curriculum takes three years to complete. For part-time students, the curriculum may take longer. Programme management presented a table, showing the curriculum to cover all of the intended learning outcomes. The first year of the curriculum is compulsory for all students and includes courses on the foundations of mathematics, such as algebra, calculus, probability and programming. In the second and third year, students opt for one of the majors and tracks offered in the programme. The majors are either pure or applied mathematics. The tracks within the majors are composed of either 18 EC or 30 EC of electives. Regardless of majors or tracks selected, all students are taught in teaching-learning trajectories throughout the curriculum the fundamentals of the fields of algebra and geometry, analysis and dynamical systems, probability and statistics, and modelling. Academic skills training is included in the modelling courses. At the end of the first-year and second-year semesters, projects are scheduled. In these projects, students apply the theory they have learnt or study literature. The projects include students writing reports and giving oral presentations on their findings. In the first semester of the third year, students take the minor. Most students take the mathematics minor. Other options are other Vrije Universiteit minors, the minor education or courses abroad. In the curriculum, students are introduced to mathematical reasoning, giving mathematical proofs, and mathematical writing. They are also taught to use mathematical or computational tools to solve quantitative problems. In the third year, the courses History of science and Ethics are offered. At the end of the curriculum, students complete the Bachelor project (12 EC).

The total number of permanent staff lecturing in the Bachelor and Master Mathematics programmes, and in the Master Stochastics and Financial Mathematics programme are 41 lecturers representing 14.3 full-time equivalents of teaching capacity in total. Most of the lecturers in the programmes are staff members from the Department of Mathematics of the Faculty of Science of Vrije Universiteit Amsterdam. In addition, lecturers in mathematics of University of Amsterdam are involved in the programme. Nearly all staff members are active researchers in their respective fields and practically all

of them have PhD degrees. About 77 % of the staff members in the Department of Mathematics are BKO-certified. Others are in the process of obtaining the BKO-certificate. All permanent staff members are BKO-certified. Junior lecturers are involved in tutorials. PhD students, postdoctoral researchers and master students lecture in tutorials as well, having been trained for this work. They are also engaged in grading assignments and examinations, under the supervision of examiners. Lecturers meet monthly to discuss aspects of teaching in the programme. In addition, lecturers in the first year meet weekly to adjust courses, whereas lecturers in the second year meet monthly to coordinate courses. Lecturers are free to organise their lectures, as long as course goals are met. Students appreciate lecturers' capabilities and accessibility. Lecturers experience the work load as challenging. About eight new positions in the Department of Mathematics are being created, among others on account of the Mathematics sector plan.

Part of the programme educational concept is to teach students to cooperate in solving mathematical problems. Study methods adopted are lectures, tutorials, computer practical sessions, and self-study. Both lecture classes and tutorials are rather small-scale, about 10 to 30 students being in class. In the tutorials, students work either individually or in small groups to solve problems and to apply the knowledge gained to these problems. Students hand in homework assignments, and receive feedback on these. Full-time students and part-time students collaborate in doing the assignments. In first year study sessions, students are taught about studying mathematics effectively. In these sessions, junior lecturers address problems students may have in mastering subjects. In the second year and third year tutorials, PhD students or teaching assistants are involved. Every one of the students meets with the academic advisor in the first year, who informs them about and advises them on the programme. The academic advisor counsels students on majors and tracks to be taken and monitors study progress in all academic years. Students may turn to the academic advisor in case of problems. Students spend at most one day per week on the University of Amsterdam campus, to take courses offered there. The drop-out rate is on average 49 %, calculated for the last five years. The student success rates are 38 % after three years and 50 % after four years (last cohort; proportions of students re-entering the programme in the second year).

Considerations

The panel considers the influx of students to be limited, but is pleased to see the number of incoming students rising in the last few years. The panel approves of the admission requirements and entry procedures of the programme. Students are adequately informed about the challenging nature of the programme. In the first year, students are appropriately taught how to study mathematics.

The curriculum of the programme matches the intended learning outcomes. The panel regards the curriculum to be appropriate, students in effect being taught the fundamentals of the various fields within mathematics. Mathematical reasoning, academic skills and research skills are covered adequately in the curriculum. As the number of majors and tracks offered in the curriculum is quite extensive and may be regarded to be somewhat confusing, the panel advises to reconsider the curriculum design, addressing both the tracks to be offered and the balance of fundamental and applied mathematics. As students in the applied mathematics major presently can avoid complex analysis, the panel recommends to make courses on this subject compulsory. In the panel's view, numerical methods should be addressed more coherently and more in-depth. The History of Science course is much appreciated by the panel, the course being lectured by an expert in this field. The panel is also

positive about the Ethics course. The panel welcomes the ad hoc curriculum committee for the renewal of the curriculum, but recommends to give this committee permanent status.

The staff members lecturing in the programme have solid research backgrounds in the fields they are lecturing and are motivated teachers. Their educational capabilities are up to standard. The panel is positive about the role of junior lecturers in assisting students in the first year. The panel notes the appreciation of lecturers by students. As the work load of lecturers is rather challenging, the panel welcomes extra staff being recruited.

The educational concept and the study methods adopted in the programme are regarded by the panel to be effective. The panel is positive about groups of no more than three students taking practical classes in modelling. The panel applauds the intensive and effective study guidance by the academic advisor. The panel suggests to schedule the moment to select one of the tracks later in the curriculum, to allow students to make well-deliberated choices. The panel considers the material facilities for the programme to be adequate, in particular after the relocation to the new building. As the drop-out rates and the student success rates are rather disappointing, the panel recommends to monitor these and to hold exit interviews on the reasons for students to leave.

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 examination and assessment procedures are aligned with the Vrije Universiteit Amsterdam policies and the Faculty of Science policies. The examinations and assessments are governed by the principles of constructive alignment, linking the course examinations to the programme intended learning outcomes. As has been indicated, the Sub-examination board for Mathematics and Business Analytics monitors the quality of examinations and assessments of this programme. This board is part of the Faculty-wide Examination board.

The examination methods for the courses are selected in line with the contents of the courses. The examination methods in the programme include written midterm examinations, written final examinations, homework assignments, programming tests, written reports or oral presentations. In most of the courses, multiple examinations are scheduled. In the first year, written examinations and homework assignments are scheduled with high frequency to train students in practising mathematics and to promote their study progress. Homework assignments may constitute no more than 40 % of the course grade to counter the effects of any free-riding. The written examinations have to constitute at least 60 % of the course grade. To pass courses, the grades of written examinations have to be at least 5 out of 10. Teaching assistants may be involved in marking course examinations, but only under examiners' supervision.

The activities within the individual Bachelor projects are scheduled rather strictly. The projects are organised by two coordinators, being staff members in the programme. In consultation with their supervisor, students select the topic for the project. All students are guided individually by their supervisor, whom they meet weekly. The project schedule is monitored and delay in projects is acted upon. Students are to present orally the intermediate results of their projects. At the end of the Bachelor projects, students hand in their written reports and give their final oral presentation. They are to present their results at fixed dates. The projects are assessed by two examiners and the Bachelor coordinator. The examiners assess the projects on the basis of assessment criteria as the thesis (50 % of the grade), attitude and execution (30 %) and final presentation (20 %). The thesis grades are to be at least 5.5 out of 10. One of the Examination board members is present at the final presentations and during the assessments of the projects.

Programme management and the Examination board have taken a number of measures to promote the quality of the examinations and assessments. The Examination Board appoints two examiners for every one of the courses. Course goals are drafted in clear terms. Draft examinations are peer-reviewed by fellow examiners. Examination matrices have been adopted. Answer models to mark examinations have to be submitted by examiners. The validity of examinations with pass rates of less than 50 % is checked by the Examination board. Students are entitled to inspect their marked examinations. Every year, the Examination board inspects 10 % of the course examinations, a number of Bachelor projects and a number of Bachelor project's assessment forms. Bachelor projects are all checked for plagiarism.

Considerations

The panel approves of the examinations and assessment rules and regulations of the programme, these being in line with Vrije Universiteit Amsterdam and Faculty of Science policies. The panel is positive about the position and the activities of the Examination board.

The panel approves of the examination methods adopted by the programme. The examination methods are consistent with the goals of the courses. The processes of marking examinations are adequate. The policies to curtail the effects of free-riding are appropriate.

The supervision and assessment processes for Bachelor projects have been well-organised. Students are offered appropriate supervision. The assessment procedures are up to standard, involving two examiners and the Bachelor project coordinator assessing the student's work. The panel, however, advises to add more extensive arguments to substantiate the assessments of the Bachelor projects. 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 considers the measures taken by the programme to assure the quality of examinations and assessments to be appropriate. The panel regards these measures as assuring valid, reliable and transparent examinations and assessments.

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.
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Findings

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

The panel reviewed the Bachelor projects of fifteen graduates of the programme with different grades from both full-time students and part-time students and from students of different tracks. In the Bachelor projects, students are to demonstrate mastering all intended learning outcomes of the programme. Bachelor projects may be research projects or literature theses. The average grade of these projects is 7.8 for the graduates of the last two years.

In the curriculum, some activities are scheduled for students' labour market orientation. From 2008 onwards, the Work field advisory board for the Mathematics and Business Analytics programmes, being composed of programme alumni and professional field representatives, advises programme management on the alignment of the programme with trends in the professional field.

Programme graduates tend not to enter the labour market. Programme graduates are admitted to a range of master programmes both in mathematics and in other disciplines, such as business analytics, computational science, econometrics or operations research. About 58 % of the graduates proceed from this programme to the Master Mathematics programme of Vrije Universiteit Amsterdam. This proportion is rather low, maybe partly being caused by part-time students not continuing their studies at master level.

Considerations

The examinations of the courses which were reviewed by the panel are of appropriate level.

The panel assesses the Bachelor projects to be up to standard. The quality of the projects varies. The panel supports the grades awarded to the projects. No Bachelor projects were found to be unsatisfactory.

As the proportion of students proceeding from this programme to the Master Mathematics programme is quite limited, the panel advises to analyse these figures.

The panel is convinced the programme graduates have reached the intended learning outcomes of the programme. Programme graduates have access to quite a large number of master programmes.

Assessment of this standard

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

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	Satisfactory
Programme	Satisfactory

6. Recommendations

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

- To reconsider the design of the curriculum, to determine the tracks to be offered and to address the balance of fundamental and applied mathematics in the programme.
- To make courses on the subject of complex analysis compulsory in the curriculum.
- To address numerical methods more coherently and more in-depth in the curriculum.
- To make the curriculum committee permanent.
- To schedule the moment to select one of the tracks later in the curriculum.
- To monitor the drop-out rates and the student success rates of the programme.
- To hold exit interviews on the reasons for students to leave.
- To add more extensive comments and arguments to substantiate the assessments of the Bachelor final projects.
- To analyse the percentages of students proceeding from this programme to the Master Mathematics programme.