STATISTICAL SCIENCE FOR THE LIFE AND BEHAVIOURAL SCIENCES

FACULTY OF SCIENCE

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CONTENTS

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REPORT ON THE MASTER'S PROGRAMME OF STATISTICAL SCIENCE FOR THE LIFE AND BEHAVIOURAL SCIENCES OF LEIDEN UNIVERSITY

This report takes the NVAO's Assessment Framework for the Higher Education Accreditation System of the Netherlands for limited programme assessments as a starting point (September 2018).

ADMINISTRATIVE DATA REGARDING THE PROGRAMME

Master's programme Statistical Science for the Life and Behavioural Sciences (StatSci)

Name of the programme:	Statistical Science for the Life and Behavioural Sciences
CROHO number:	60957
Level of the programme:	master's
Orientation of the programme:	academic
Number of credits:	120 EC
Specializations or tracks:	- Statistical Science for the Life and Behavioural Sciences (LBS) - Data Science: Statistical Science (DS)
Location:	Leiden
Mode of study:	full time
Language of instruction:	English
Submission deadline NVAO:	1 November 2020

The online meetings of the assessment panel Statistical Science with the Faculty of Science of Leiden University took place on 8 and 9 June 2020.

ADMINISTRATIVE DATA REGARDING THE INSTITUTION

Name of the institution:	Leiden University
Status of the institution:	publicly funded institution
Result institutional quality assurance assessment:	positive

COMPOSITION OF THE ASSESSMENT PANEL

The NVAO has approved the composition of the panel on 26 March 2020. The panel that assessed the master's programme Statistical Science for the Life and Behavioural Sciences consisted of:

- Prof. dr. E.C. (Ernst) Wit, professor in Statistics and Data Science at the Institute of Computational Science of Università della Svizzera italiana [chair];
- Em. Prof. dr. C.A.W. (Cees) Glas, professor in Social Science Research Methodology at the Faculty of Behavioural, Management and Social sciences of University of Twente;
- Prof. dr. M.E. (Marieke) Timmerman, professor in Multivariate Data Analysis at the Faculty of Behavioural and Social Sciences of University of Groningen;
- M. (Maartje) Stokvis MSc., graduated from the master's programme Data Science for Decision making at Maastricht University [student member].

The panel was supported by P.A. (Peter) Hildering MSc., who acted as secretary.

WORKING METHOD OF THE ASSESSMENT PANEL

On behalf of Leiden University, quality assurance agency QANU was responsible for logistical support, panel guidance and the production of the report. Peter Hildering was project coordinator for QANU and acted as secretary in the assessment.

Panel members
The members of the assessment panel were selected based on their expertise, availability and independence. The panel consisted of the following members:

- Prof. dr. E.C. (Ernst) Wit, professor in Statistics and Data Science at the Institute of Computational Science of Università della Svizzera italiana [chair];
- Em. Prof. dr. C.A.W. (Cees) Glas, professor in Social Science Research Methodology at the Faculty of Behavioural, Management and Social sciences of University of Twente;
- Prof. dr. M.E. (Marieke) Timmerman, professor in Multivariate Data Analysis at the Faculty of Behavioural and Social Sciences of University of Groningen;
- M. (Maartje) Stokvis MSc., graduated from the master's programme Data Science for Decision making at Maastricht University [student member].

Preparation
On 14 April 2020, the panel chair was briefed by QANU on its role, the assessment framework, the working method, and the planning of site visits and reports.

Before the site visit to Leiden, QANU received the self-evaluation reports of the programme and sent these to the panel. A thesis selection was made by the panel's chair and the project coordinator. The selection consisted of 15 theses and their assessment forms, based on a provided list of graduates between 2018-2020. The selection consisted of six theses of the LBS specialization, eight theses for the DS specialization and one thesis of a student with a tailor-made curriculum. A variety of topics and a diversity of examiners were included in the selection. The project coordinator and panel chair assured that the distribution of grades in the selection matched the distribution of grades of all available theses.

At the end of March 2020, it became clear that due to the COVID-19 pandemic all universities would be closed until further notice. Leiden indicated to be interested in organizing a digital site visit. First, the project coordinator asked the panel chair whether he would be willing to lead a digital assessment. After his consent, the panel members involved also confirmed their consent in partaking in an assessment by digital means. It was decided that the online assessment of the programme would take place on 8 and 9 June 2020, but only if the panel would conclude in the preparation meeting that no hindrances were found in the documentation that would make an actual site visit necessary based on the study of existing documents, a so-called 'go/no go-decision'. Furthermore, the set-up of the online site visit was discussed with the organizers of another online site visit in the same period, that is with the Vrije Universiteit Amsterdam.

After studying the self-evaluation report, theses and assessment forms, the panel members formulated their preliminary findings. The secretary collected all initial questions and remarks on the self-evaluation report and the theses and distributed these amongst all panel members. The initial findings were discussed during a preparatory panel meeting, which was organized on 2 June 2020. Based on this discussion, the panel formulated a 'go' for the online site visit. During this meeting, the panel members received instruction on the use of the assessment framework(s). The panel also discussed their working method and the planning of the site visit and report during this meeting. Based on the panel's initial findings as formulated after their study of the documentation, a list of factual questions was drawn up by the panel secretary and sent to Leiden prior to the site visit. On 5 June, the panel received the answers to these questions from Leiden.

The project coordinator composed a schedule for the online assessment in consultation with the programme and the panel chair. Prior to the assessment, the programme selected representative

partners for the various interviews. See Appendix 3 for the final schedule. Also, a digital protocol was drawn up by Leiden with input of the project coordinator and panel chair. This protocol discussed the ways in which communication during the interviews would be organized to guarantee that all interviewees and panel members would be able to speak freely and add to the conversation. Leiden provided the necessary software (Kaltura Live Room) to enable a digital site visit and development dialogue.

Site visit
The site visit to Leiden took place on 8 and 9 June 2020 by digital means. Before and during the site visit, the panel studied the additional documents provided by the programme. An overview of these materials can be found in Appendix 5. The panel conducted interviews with representatives of the programme: students and staff members, the programme's management, alumni and representatives of the Board of Examiners. It also offered students and staff members an opportunity for confidential discussion during a consultation hour ahead of the digital site visit. QANU provided a dedicated digital environment for this meeting in order to guarantee privacy. No requests for such private confidential consultation were received. The panel used the final part of the site visit to discuss its findings in an internal meeting. Afterwards, the panel chair presented the panel's preliminary findings and general observations. This last digital time slot could be accessed by all willing to attend.

Development dialogue
A development dialogue took place by digital means at 9 June 2020 during the second meeting with the programme management. For this dialogue, the programme prepared an agenda. The outcomes of the future development dialogue have been drawn up separately, confirmed by the panel chair, in a separate document that is not part of the application for accreditation.

Report
After the site visit, the secretary wrote a draft report based on the panel's findings and submitted it to a colleague at QANU for peer assessment. Subsequently, the secretary sent the report to the panel. After processing the panel members' feedback, the project coordinator sent the draft report to the Faculty in order to have it checked for factual irregularities. The project coordinator discussed the ensuing comments with the panel's chair and changes were implemented accordingly. The report was then finalized and sent to the Faculty and University Board.

Definition of judgements standards
In accordance with the NVAO's Assessment framework for limited programme assessments, the panel used the following definitions for the assessment of the standards:

Generic quality
The quality that, from an international perspective, may reasonably be expected from a higher education Associate Degree, Bachelor's or Master's programme.

Meets the standard
The programme meets the generic quality standard.

Partially meets the standard
The programme meets the generic quality standard to a significant extent, but improvements are required in order to fully meet the standard.

Does not meet the standard
The programme does not meet the generic quality standard.

The panel used the following definitions for the assessment of the programme as a whole:

Positive
The programme meets all the standards.

Conditionally positive
The programme meets standard 1 and partially meets a maximum of two standards, with the imposition of conditions being recommended by the panel.

Negative
In the following situations:
- The programme fails to meet one or more standards;
- The programme partially meets standard 1;
- The programme partially meets one or two standards, without the imposition of conditions being recommended by the panel;
- The programme partially meets three or more standards.

SUMMARY JUDGEMENT

The master's programme StatSci is a unique educational programme in the Netherlands taught by prominent statisticians, offering a coherent curriculum with very good career opportunities for students. It is open to students with a variety of backgrounds and provides their students with a solid methodological basis as the fundamental core of statistics and data science. The panel explicitly wants to note the enthusiasm it encountered in talking to the staff, management, students and the Examination Board. The main recommendation is with respect to the improvement of the study success rate, which will be further discussed below. The panel recommends the programme to make a serious effort to increase this, in particular with regard to the bottlenecks of thesis duration, internship placement and study load.

Intended learning outcomes
The programme that connects knowledge of techniques and models of statistics and data science to the application domains in which these are used. By admitting bachelor's graduates from the application domains and training them in applied statistics, it aims to create multidisciplinary researchers and professionals that can combine theory and application. The partners involved in the programme each add to its multidisciplinarity. The panel recommends the programme to nurture this unique profile in the planned curriculum change, maintaining a core of statistics and data science, and allowing students to specialize in a research or application domain through learning lines. The programme's goals have been well translated into a coherent set of ILOs that reflect the academic orientation and master's level of the programme. They are aligned with the requirements and expectations of the field, as demonstrated, for example, through international recognition of the programme by the EMOS network. The panel recommends a more formalized advisory role of the professional field in the programme, for instance through the future alumni network.

Teaching-learning environment
The programme has adequately translated its intended learning outcomes into a coherent curriculum that takes students to an advanced level of statistics and data science at the end of the programme. The courses show a mix of theory and practice that is fitting to the profile of the programme. The curriculum allows students to shape it to their own preferences, which will be further developed in the planned merger of the two specializations. The panel recommends introducing learning lines into the programme to make the coherence of the curriculum visible to students, and to support the alignment of course content on a curriculum level. The teaching staff is of high quality, both in terms of expertise and didactic skills, and forms a motivated team. The use of English as language of instruction is well-motivated and implemented and fits the internationally oriented field in which students are likely to work.

As the curriculum is currently very challenging to complete within two years, the feasibility of the programme needs to be improved. The panel recommends checking the curriculum thoroughly on the allocated amount of EC per course and per semester. In particular, the scheduling and time management of the thesis and internship need attention. The panel recommends supporting students better in finding an internship position, and to closely monitor the progress of students with their thesis for timely completion. In addition to the recently introduced stricter entry requirements, the panel recommends investing in expectation management for prospective students and investigating possibilities for a pre-master's programme for students with non-technical backgrounds. The panel is confident that the programme management is aware of the issues concerning the feasibility of the programme, and that the measures implemented earlier and those recommended above will help to improve the programme's feasibility. The programme mentioned their plans to work on internationalization. In the view of the panel, this is not a priority at this moment. Instead of organizing the curriculum in such a way that it can be reconciled with an international exchange, all attention must first be focused on redesigning the programme to improve study success.

Assessment
The programme has an adequate assessment system that assesses students on all intended learning outcomes. The assessment methods are varied and fit the goals of the programmes. The four-eye principle is used for the composition of written exams, internship and thesis assessment and add to the reliability and validity of assessment. The panel recommends making this principle not only mandatory for the internship and thesis, but also for the composition of written exams to ensure its implementation in all cases. The assessment system could be further improved by coupling the assessment plan to the learning trajectories the panel recommended under Standard 2. The internship and thesis assessments are sound. The thesis assessment forms that the panel studied were well-designed and allowed for a solid underpinning of the final grade. The panel recommends making the inclusion of substantive qualitative feedback mandatory, as in some cases, the forms were not used to their full potential. The Board of Examiners proactively fulfils its role in the quality assurance of assessment and has sound procedures in place to monitor the quality of exams and theses.

Realized learning outcomes
The panel concludes that theses of the programme are generally of a high quality, and convincingly show that the intended learning outcomes of the programme are achieved. The panel agrees with the grading and praises the programme with the high level that students from both technical and non-technical backgrounds attain at the end of the programme. This is further reflected in the high number of students continuing in academics. The graduates of the master's programme are very much in demand on the job market, with most students finding a job immediately after graduation.

The panel assesses the standards from the *Assessment framework for limited programme assessments* in the following way:

Master's programme Statistical Science for the Life and Behavioural Sciences

Standard 1: Intended learning outcomes	meets the standard
Standard 2: Teaching-learning environment	meets the standard
Standard 3: Student assessment	meets the standard
Standard 4: Achieved learning outcomes	meets the standard
General conclusion	positive

The chair, prof. dr. E.C. (Ernst) Wit, and the secretary, P.A. (Peter) Hildering MSc., of the panel hereby declare that all panel members have studied this report and that they agree with the judgements laid down in the report. They confirm that the assessment has been conducted in accordance with the demands relating to independence.

Date: 17 September 2020

DESCRIPTION OF THE STANDARDS FROM THE ASSESSMENT FRAMEWORK FOR LIMITED FRAMEWORK ASSESSMENTS

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

Profile
The master's programme Statistical Science for the Life and Behavioural Sciences (StatSci) is a joint collaboration between three faculties of Leiden University: the Faculty of Science (FWN), the Medical Centre (LUMC) and the Faculty of Social and Behavioural Science (FSW), and the Biometris institute of Wageningen University & Research (WUR). The programme is primarily embedded in the Mathematical Institute at FWN, which provides the programme management and support staff, and is responsible for the overall quality of the programme.

The StatSci programme aims to provide students with a broad knowledge and understanding of statistics and data science, and the role these fields play in science and society. It teaches students techniques and models for performing statistics and data science, as well as how to apply these in practical settings in society and industry. It has a special focus on applications in the life and behavioural sciences and is linked to these application areas through the staff members at LUMC, FSW and WUR. A special feature of StatSci is that it is not only open for students with a bachelor's degree in statistics and mathematics, but also to bachelor's graduates from the application domains such as psychology or life sciences, as long as they have a sufficient basis in quantitative methods.

The programme has two specializations. *Statistical Science for the Life and Behavioural Sciences (LBS)* covers statistics in the broad sense, with a special focus on biostatistics (for the medical and life sciences) and statistics for the behavioural sciences. *Data Science (DS)* is offered in collaboration with the computer science institute LIACS and combines statistics with data science techniques. Currently, students choose one of the two specializations at the start of the programme and follow the associated curriculum. In the near future, the programme is planning to drop the distinction between the two specializations and replace this with a more open curriculum in which students can compose their own study path. To this end, the programme proposes to change its name into *Statistics and Data Science* (see for a discussion Appendix 4).

The panel studied the profile of the programme and discussed this with programme's representatives. The panel is very positive on the unique positioning of the programme as a broad applied statistics and data science programme. It states that the StatSci programme offers a strong fundamental core in mathematical statistics. By collaborating with the life, medical and behavioural sciences through the partners at UMC, FSW and WUR, and by admitting bachelor's graduates from the application domains, it has the unique position to educate researchers and professionals that are knowledgeable in both statistics and its application domains. According to the panel, the programme has clearly strengthened its multidisciplinarity with regard to the application domains compared to the initial accreditation, as recommended by the previous panel. Another notable development is the growing role of data science, which is currently the largest in terms of numbers of students of the two specializations. The panel thinks that the further inclusion of data science, a rapidly growing field with a large demand for experts from the professional field, is a sensible and well-timed decision. Data science and applied statistics are partially overlapping domains and fit naturally together in a single programme. The panel thinks that the planned curriculum change that drops the distinction between the two specializations makes sense. When determining the core of this curriculum, the panel advises to focus on a core of statistics and data science and allow students to specialize further within a research and application domain of their choice through structured learning lines suggesting a coherent combination of courses.

Intended learning outcomes
The programme has translated its goals into a set of 24 Intended Learning Outcomes (ILOs), which are included in Appendix 1. The ILOs are grouped in five categories that correspond with the Dublin Descriptors for academic master's programmes. The ILOs are identical for both specializations, as the core knowledge and skills provided to students are the same in specializations. Differentiation between the specializations is constituted by the depth of knowledge and amount of experience provided to students on specialization-specific topics.

In 2019, the programme acquired the European Master of Official Statistics (EMOS) label, becoming a member of the network of 32 European master's programmes of statistics. In acquiring this label, the EMOS network established that the ILOs of the programme adhere to the international requirements for programmes in statistics and are comparable to academic applied statistics programmes in the UK and the USA, where statistics is considered a discipline separate from mathematics. To align itself with the expectations of the professional field, the programme uses its network of national and international societal and industrial partners, in particular through its members in LUMC and WUR, as well as through direct relations with individual partners such as Statistics Netherlands (CBS), Johnson & Johnson and Bayer.

The panel studied the ILOs of the master's programme StatSci and concludes that they form a convincing and well-structured overview of the main goals of the programme, translated into the knowledge and skills to be acquired by the students. The structuring of the ILOs alongside the Dublin Descriptors guarantees that they meet the master's level and academic orientation. The EMOS label is a clear additional demonstration of the alignment of the programme to the international requirements of the field and is considered by the panel to be an important recognition by peers. Furthermore, the panel is impressed by the connections of the programme staff with the professional field. This is important to the proper alignment of the programme with the requirements of this professional field. The panel thinks that the programme could further benefit from this by giving the professionals from the field a more formal advisory role in the programme. The alumni network, which the programme is planning to launch, could further support the alignment with the professional field, as graduates end up in a wide variety of professional organizations.

Considerations

The master's programme StatSci is a unique programme that connects knowledge of techniques and models of statistics and data science to the application domains in which these are used. By admitting bachelor's graduates from the application domains and training them in applied statistics, it aims to create multidisciplinary researchers and professionals that can combine theory and application. The partners involved in the programme each add to its multidisciplinarity. The panel recommends the programme to nurture this unique profile in the planned curriculum change, maintaining a core of statistics and data science, and allowing students to specialize in a research or application domain through learning lines. The programme's goals have been well translated into a coherent set of ILOs that reflect the academic orientation and master's level of the programme. They are aligned with the requirements and expectations of the field, as demonstrated, for example, through international recognition of the programme by the EMOS network. The panel recommends a more formalized advisory role of the professional field in the programme, for instance through the future alumni network.

Conclusion

Master's programme Statistical Science for the Life and Behavioural Sciences: the panel assesses Standard 1 as 'meets the standard'.

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

Curriculum
The 120 EC curriculum of the programme consists of core courses (53 EC), specialization-specific courses and electives (33 EC), an internship (10 EC) and the thesis (24 EC). The full curriculum is included in Appendix 2. Students choose a specialization before or shortly after the start of the programme and follow the associated curriculum. In line with the programme's profile, most courses combine theory and application. They include lab work and/or group assignments, in which students learn how to implement the techniques and models and practice their soft skills through group work.

The first year focuses on the core and specialization courses. Students start with core courses in mathematics and computing, which add and expand on the knowledge students acquired in their diverse bachelor's programmes and brings them to a common level of understanding before encountering the more advanced statistical techniques. The first semester of the second year adds more advanced specialization and elective courses, as well as the mandatory course Statistical Consulting, in which students work on real-life statistical questions provided by external research or professional organizations. Because the programme considers this a keystone course within the curriculum that brings the knowledge and skills together, students are required to have completed 45 EC of core courses before attempting this course. The elective courses add up to 24 EC for LBS and 12 EC for DS. Half of the elective courses are to be chosen from a restricted list; the other half of the courses can be chosen freely upon approval of the Board of Examiners. Students usually choose electives that align with either their internships or thesis topics to develop a distinctive profile for graduation.

The programme is completed by an internship and thesis. Both the internship and thesis run parallel, with a focus on the first semester for the internship, and a focus on the second semester for the thesis. The internship can be done full-time (7 weeks) but is sometimes also done by students on a part-time basis. It aims to make students familiar with their future working environment as a statistician or a data scientist. It can take the form of a research internship at one of the participating academic institutions or an external internship in industry. The thesis is an individual research project separate from the internship, and can be theoretical or applied, depending on the individual profile and interests of the student.

The panel studied the curriculum and the content of a number of courses, and discussed it with the programme management, students and teaching staff. It concludes that the curriculum has a solid design that take students to an advanced level of statistics at the end of the programme. The courses show a mix of theory and practice that is fitting to the profile of the programme and is appreciated by students. The internship and thesis both reflect a suitable mix of theory and practice and allow students to specialize towards either a research or professional career.

The courses follow each other and build upon each other in a logical manner. Coordinators of subsequent courses said they consult each other before the start of a new semester to align the content of courses. The panel however noted from the interviews that this coherence of the curriculum is not always apparent to students. It thinks that the programme could benefit from a more explicit structure that can be shared with students. This could take the form of learning lines that show how knowledge and skills in different areas build up throughout the curriculum.

Furthermore, the panel thinks that it would be better to formalize the procedure for the alignment between courses, rather than to rely upon staff initiatives. Teaching staff report that the informal system works well, but the panel thinks that an organized approach would form a better safeguard

against the creeping in of misalignment between courses, especially when new teaching staff member is involved. Alignment alongside learning lines would be a natural place to start.

Feasibility
During the site visit, the panel discussed the feasibility of the curriculum with the various programme representatives. The motive for this discussion was the poor completion rate. Of the first cohort of 2016, only three students (12%) graduated within two years and 65% within three years. For the 2017 cohort, none of the students graduated within two years. At the time of the site visit in June 2020, only 38% of this cohort had graduated.

The programme management shares the panel's concerns about the completion rate and indicated that it is in a process of identifying and addressing the underlying issues. It shared a number of findings with the panel on the cause of these low completion rates. The programme management considers the curriculum to be feasible when students invest the full 40 hours per week. However, many students are not able to do this, because of side activities, such as a part-time job to finance their studies, an attractive part-time job in industry due to the high demand for graduates, and/or a second master's programme. Further, students tend to spend much more time on the internship and thesis than scheduled. For the internship, this often has a practical reason. It can be hard for students to find a suitable position, as a short 10 EC internship is often not attractive to companies. As a result, students sometimes take a long time to find a position or accept a position with a longer and full-time duration with the associated study delay. For the thesis, students often push themselves to deliver high-quality work, and lose sight of the limited time that they are supposed to spend on their work. Finally, the background of students is rather diverse. The programme noted that students without a substantial mathematical background struggled with the level of the programme. This led to a strengthening of the admission criteria since 2018: students are required to have a basic knowledge of calculus (at least the level of Dutch vwo Wiskunde B) and have accumulated at least 20 EC in statistics, advanced methodology and/or mathematics with an average grade of 7.5/10 during their bachelor's programme. The programme has already taken a number of other measures to improve the completion rate. This includes offering the course Statistical Consulting, for which there are strict entry requirements, twice per year, scheduling self-study time in the curriculum and strengthening the internship and thesis supervision.

The panel partly agrees with the diagnosis of the programme. With regard to the reasons present, it considers students that decide to study part-time out of personal circumstances to be beyond the span of control of the programme. However, the panel thinks that the scheduling and time management of the thesis and internship, as well as the handling of the broad backgrounds of the admitted students need to be addressed in order to give all students a fair chance to complete the programme in the designated two years.

In general, the panel recommends the programme to revisit the feasibility of the curriculum in full. It understood from the student interviews that for many students the scheduled time for courses corresponding to their association credits is not sufficient. Furthermore, the study load varies between semesters due to planning issues. The panel recommends reviewing whether the number of EC assigned to each course is accurate for the typical student, and whether the study load is evenly distributed throughout the two years. It notes that many students use a floating planning for the internship and thesis. They spread it over multiple semesters and follow courses alongside their thesis and internship work. While this gives students the flexibility to compose their curriculum as they see fit, the panel observes that in practice, students delay the thesis and/or internship when it interferes with their (often challenging) courses. The panel recommends investigating whether the thesis and internship can get a more fixed place in the curriculum, without scheduling courses in parallel. The results of these reviews and investigations should be used to adapt the programme such that it becomes feasible to complete the programme within two years for the typical student.

With regard to the internship, the panel thinks that too much time is lost in finding a suitable internship position. Students should receive more guidance and support, especially considering the

challenging conditions (short duration and/or part-time format) imposed by the programme. According to the panel, students should be able to find a position, follow the internship and report on their results within the time reflected by the allocated EC. It suggests that the programme creates a database of suitable internship projects for students to choose from, possibly in cooperation with a number of committed external partners. For the thesis, the panel feels that supervision needs to be improved and extended to include progress and time management. The theses that the panel read were in general of high quality, but also gave the impression that much more time than 24 EC was spent on them. Students confirmed this in the interviews and indicated that they felt that they were not expected to stick to a certain time frame for completion of the thesis. The panel recommends implementing such a time frame for the thesis, and to structurally monitor the progress of students as part of the supervision. The programme could also consider adding time management as an assessable skill to the thesis assessment.

As mentioned under Standard 1, the panel agrees that the openness to non-technical/non-mathematical students is a very valuable characteristic of the programme. The panel stresses that this requires careful management of expectations and guidance for (prospective) students for which the more technical courses of the programme can be very challenging. Although a recent check by the Board of Examiners found no courses with structurally low success rates compared to other courses (see Standard 3), some students remarked to the panel that they and their fellow students had to work very hard to successfully complete their courses. As a result, some students took fewer courses per semester than would be required for a nominal study pace, thereby resulting in study delay. The panel applauds the adaptation of the entry requirements the programme has recently adopted and thinks that the programme could benefit from extending this to the softer side of the intake procedure. Expectation management could help prospective students with self-selection, for instance through matching interviews or assignments through which students can find out whether the programme fits their interests and skills. If this does not have the desired effect on success rates, the programme should consider introducing a pre-master's programme, in which non-technical students catch-up on their mathematical skills before entering the programme.

The panel is assured that the programme management is aware of the issues concerning the feasibility of the programme. Already before the site visit, the programme stated that improving the poor completion rates of the programme was their highest priority, and this was further confirmed during the site visit interviews. The panel is confident that the measures implemented earlier and those discussed above will help to improve the programme's feasibility, and that students are better enabled to complete the programme in the designated time.

Student-centeredness, support and guidance
Students have the opportunity to shape their curriculum to their preferences by choosing one of the two specializations, choosing electives (especially in the LBS specialization) and opting for either a research or professional internship and for either a research or applied thesis. In the envisioned curriculum update when the two specializations are merged, students will get more flexibility to choose a personalized curriculum. The panel is positive about these planned changes but suggests helping students to choose a coherent set of courses by creating a number of pre-selected trajectories for students to choose from. The programme management also shared plans to create opportunities for an international exchange semester. While the panel applauds internationalization initiatives in general, it worries that in the current curriculum structure this might cause additional study delay. It recommends shelving these plans for the time being until the feasibility issues of the curriculum have been solved.

Students reported to the panel that they feel adequately supported by the programme. The programme committee members felt that they were heard, and their recommendations are taken seriously. The study advisor is available at the request of students to help them with all kinds of issues students encounter, and the teaching staff is open and approachable. The panel did note from the student remarks that until recently, the initiative for finding support lay primarily with the students. According to the panel, this has the associated risk that students can fly under the radar

of the programme if they do not seek support themselves. During the interviews with the programme management, students and teaching staff, the panel heard some examples of students who progressed slowly throughout the programme for unknown reasons. Recently, the study advisor has taken a more active role, inviting all students that obtain few credits for a meeting. The panel thinks that this is a good development and recommends the programme to continue onto this path to formalize the system of support to ensure that all students remain in focus.

With regard to career preparation, both students and alumni felt well-supported and equipped. The internship, thesis and the course Statistical Consulting provide insight into possible careers as a statistician, both in academia and in the professional field. Furthermore, the programme offers an elective core module in which students learn methods and statistical practices in the domain of professional statistics in the context of EMOS. It is offered at the CBS by lecturers from the CBS and prepares for a career as professional statistician. The panel approves of the career preparation within the programme and thinks that students are well-informed and prepared for their future career.

Students were generally satisfied with the facilities offered by the programme. There is sufficient room in the building for both group and individual work. All participants of the interviews commented on the dated state of the building, for instance with regard to utilities and climate. A new accommodation has been planned and will be available in 3-4 years. The panel supports these plans to address the limitations of the current facilities.

Teaching staff
The programme is taught by a team of teaching staff from various institutes of all four participating faculties of Leiden and Wageningen. The programme embraces a research-based educational philosophy, meaning that all teaching staff has a PhD in statistics or in a related domain, and is an active researcher in that field. All teaching staff is required to show or obtain a University Teaching Qualification (UTQ), which demonstrates didactic skills. To qualify as a thesis supervisor, teachers need to be a permanent staff member of one of the faculties. To support first-year students during practice sessions, the teaching staff is assisted by teaching assistants, who are selected among the second-year students and among PhD students. There are currently 42 teaching staff members within the programme, and 54 counting external lecturers. With an intake of approximately 50 students per year, this is sufficient capacity with room for growth.

The programme has taken an effort to involve all partners equally in the quality assurance of the programme. All four faculties are represented in the formal bodies of the programme (Programme Committee, Board of Examiners and Board of Admissions), and a Steering Committee consisting of representatives of the four faculties as well as a student representative discuss strategic and financial matters with the programme management. To improve coherence amongst the staff members, each course has a course coordinator that discusses the contributions with the various teachers, and, if necessary, the coordinator of related courses.

The panel acknowledges of the quality of the teaching staff. They are experts in the field with national and international recognition. Students reported positively on both the expertise and didactic skills of their teachers. The panel got the same impression from the interviews with the teaching staff, showing them to be a dedicated and motivated team. The obligatory UTQ ensures that all staff has the same basis of professionalization, answering the recommendation of the previous panel to more actively promote the advancement of didactic skills. The panel is positive with regards to the efforts to achieve coherence in the diverse teaching team. As recommended under 'Curriculum' the panel does think this could be more formalized. According to the panel, there is sufficient teaching capacity to handle the growth of students that the programme expects in the coming years.

Teaching language
The master's programme StatSci is offered in English, as the programme considers this the common language for both the academic and professional field of statistics. As active researchers in the field, all the teaching staff sufficiently master the English language. Upon hiring, the university requests

teachers to either show or obtain a Qualification of English Proficiency at level C1. This qualification can be obtained as part of the UTQ for new teaching staff. Students are satisfied with the English language proficiency of their teachers. The panel fully supports the use of English in the master's programme, considering that statistics is a very internationally oriented field, in which students are likely to work in an English-language professional or academic environment. The panel is positive about the proficiency qualification required of the teaching staff, as well as with the level of English of the students as it was presented in the theses read by the panel.

Considerations

The programme has adequately translated its intended learning outcomes into a coherent curriculum that takes students to an advanced level of statistics and data science at the end of the programme. The courses show a mix of theory and practice that is fitting to the profile of the programme. The curriculum allows students to shape it to their own preferences, which will be further developed in the planned merger of the two specializations. The panel recommends introducing learning lines into the programme to make the coherence of the curriculum visible to students, and to support the alignment of course content on a curriculum level. The teaching staff is of high quality, both in terms of expertise and didactic skills, and forms a motivated team. The use of English as language of instruction is well-motivated and implemented and fits the internationally oriented field in which students are likely to work.

As the curriculum is currently very challenging to complete within two years, the feasibility of the programme needs to be improved. The panel recommends checking the curriculum thoroughly on the allocated amount of EC per course and per semester. In particular, the scheduling and time management of the thesis and internship need attention. The panel recommends supporting students better in finding an internship position, and to closely monitor the progress of students with their thesis for timely completion. In addition to the recently introduced stricter entry requirements, the panel recommends investing in expectation management for prospective students and investigating possibilities for a pre-master's programme for students with non-technical backgrounds. The panel is confident that the programme management is aware of the issues concerning the feasibility of the programme, and that the measures implemented earlier and those recommended above will help to improve the programme's feasibility.

Conclusion

Master's programme Statistical Science for the Life and Behavioural Sciences: the panel assesses Standard 2 as 'meets the standard'.

Standard 3: Student assessment
The programme has an adequate system of student assessment in place.

Findings

Assessment system
The programme adheres to the assessment policy and exam regulations of the Faculty of Science. The assessment policy prescribes an assessment plan that contains an overview of the learning goals for the entire curriculum, coupled to the various exams within the courses. Assessment of a course consists of multiple elements and the assessment methods are fitting to the learning outcomes involved. Frequently used forms of assessment are written exams, assignments, presentations and reports. If group work is a part of the assessment, this never accounts for more than 40% of the total grade to prevent free-riding. The Turnitin software is used systematically to detect plagiarism in theses, internship reports and most of the homework assignments. Usually, teachers involved in a course cross-check each other's questions or assignments (four-eye principle), although it is not a general rule. In response to the recommendation of the previous assessment panel to give students

more time to prepare for resits, the programme has scheduled more time between the exam and the resit. The students the panel interviewed were satisfied with this improvement.

The panel studied the assessment system of the programme, an overview of the assessment methods and criteria per course, and some examples of exams used within the programmes. It concludes that the assessment methods are varied and well-balanced, and that course assessment goals align with the intended learning outcomes of the programme, as demonstrated in the assessment plan. The panel suggests that this assessment plan could be aligned with the learning trajectories recommended under Standard 2 in order to make the progression of knowledge and skills visible to students and help maintain coherence in the programme. The panel is positive about the attention to prevention and detection of plagiarism and fraud. The four-eye principle for composing exams and assignments adds to the reliability of the assessment. To safeguard the implementation of this throughout the programme, the panel recommends formalizing this good practice, as was also recently recommended by the programme's Board of Examiners.

Assessment thesis and internship
The internship and thesis are always assessed and supervised by a scientific staff member of one of the partner institutes. In case of an external project, the local supervisor has an advisory role in the assessment. The internship is graded using an assessment form and includes partial marks for the quality of the written report, statistical skills, research skills and communication skills. The internship coordinator is the second reader for all internship reports, following the four-eye principle. The panel approves of the solid assessment procedure for the internship and is of the opinion that this makes it clear that students achieve learning goals associated with the internship.

The thesis project is independently assessed by two independent examiners: the supervisor and a second examiner not directly involved in the project. Each thesis needs to be approved for formal submission by the thesis coordinator. The assessment focuses on four criteria: the written thesis, execution of the project, the presentation and defence. The written thesis (both examiners) and the execution of the project (the supervisor) are already assessed before the graduation session. After the session, both examiners decide collectively on a grade for the presentation and defence with a member of the Board of Examiners as (non-examining) session chair. They also harmonize their findings on the written thesis and register this on a standardized assessment form. The final grade is a weighted average of the four criteria, with the thesis itself accounting for the largest part (50%). Every thesis is checked for plagiarism using the Turnitin software archive.

The panel has studied the assessment form and the use thereof in a selection of 15 theses of the programme. It concludes that the assessment procedure for research projects is sound and the structure of the assessment form promotes a transparent grading process. The independent second reader increases the validity of the grading, and the Board of Examiners closely monitors the process by providing a session chair for all graduation sessions. The assessment form uses sub criteria and rubrics to further substantiate the grades given per criterion. However, for some of the studied theses, the relation to the final grade and the subgrades was not always obvious to the panel. In some cases, the qualitative feedback on the form provided insights in the reasoning of the examiners, but in other cases where it would have been helpful this feedback was missing. The panel recommends making the inclusion of substantive qualitative feedback on the assessment forms mandatory to further improve the transparency of the thesis assessment.

Boards of Examiners
The StatSci programme has its own Board of Examiners, consisting of members of each of the four participating faculties, and an external member from a related statistics master's programme. The Board monitors the quality of assessment within the programme. It does this through a review of all exams in a two-year cycle on topics such as pass/fail percentages, consistency in grading and coverage of all the programme's ILOs in the curriculum. The Board reported no major shortcomings and found no outliers in success rates of the individual courses. It did note that the four-eye principle was not fully implemented in the composition of all exams and assignments and recommended to

make this mandatory. In addition, the Board checks a sample of theses annually for each of the programmes in terms of adequate grading and thesis quality. The external Board member plays a prominent role in this regard by comparing the thesis quality to that of a similar programme. As discussed above, the Board also provides all session chairs for the thesis defence sessions, and therefore has direct insight in the discussions on thesis grades between examiners.

The panel spoke with the Board of Examiners and studied a number of their annual reports. It judged that the Board adequately and proactively fulfils its role in the quality assurance of assessment within the programme. The quality assurance measures the Board has in place are fitting and contribute to the validity of the assessment within the programme. The panel was particularly impressed by the involvement of the Board in the viva sessions, allowing them to monitor the consistency and validity of thesis grading. It recommends the Board to use this role to verify that all examiners completely fill in the assessment form, including substantive qualitative feedback (see above).

Considerations

The programme has an adequate assessment system that assesses students on all intended learning outcomes. The assessment methods are varied and fit the goals of the programmes. The four-eye principle is used for the composition of written exams, internship and thesis assessment and add to the reliability and validity of assessment. The panel recommends making this principle not only mandatory for the internship and thesis, but also for the composition of written exams to ensure its implementation in all cases. The assessment system could be further improved by coupling the assessment plan to the learning trajectories the panel recommended under Standard 2. The internship and thesis assessments are sound. The thesis assessment forms that the panel studied were well-designed and allowed for a solid underpinning of the final grade. The panel recommends making the inclusion of substantive qualitative feedback mandatory, as in some cases, the forms were not used to their full potential. The Board of Examiners proactively fulfils its role in the quality assurance of assessment and has sound procedures in place to monitor the quality of exams and theses.

Conclusion

Master's programme Statistical Science for the Life and Behavioural Sciences: the panel assesses Standard 3 as 'meets the standard'.

Standard 4: Achieved learning outcomes
The programme demonstrates that the intended learning outcomes are achieved.

Findings

Prior to the site visit, the panel studied 15 theses of the programme StatSci, divided over the two specializations. The panel concludes that the theses are generally of high quality and show that the students in both specializations realize the learning outcomes of the programme. The panel did note that the theses frequently reflected more work than the assigned 24 EC. This was previously discussed under Standard 2. It generally agreed with the grades awarded by the programme. The panel compliments the programme with this achievement, which is especially remarkable considering the diverse intake of students. Students in both specializations show a good command of the mathematical aspects of statistics, as well as its practical applications. According to the programme, student projects regularly contribute to scientific publications in the field.

The graduates of the programme are in high demand, both as PhD students and in industry. Approximately 50% of graduates continue in a PhD position, the other 50% finds a job in a professional field. Employers include banks, insurance companies, the government and ICT companies. Most find a job immediately after graduation. The alumni the panel interviewed were

satisfied with the programme and felt well-prepared for their future career. The panel praises the programme for the performance of its graduates, and in particular thinks that 50% continuation in a PhD programme is very high, especially considering the pull for students from industry. It considers this further proof of both the high quality and high motivation of the students.

Considerations

The panel concludes that theses of the programme are generally of a high quality, and convincingly show that the intended learning outcomes of the programme are achieved. The panel agrees with the grading and praises the programme with the high level that students from both technical and non-technical backgrounds attain at the end of the programme. This is further reflected in the high number of students continuing in academics. The graduates of the master's programme are very much in demand on the job market, with most students finding a job immediately after graduation

Conclusion

Master's programme Statistical Science for the Life and Behavioural Sciences: the panel assesses Standard 4 as 'meets the standard'.

GENERAL CONCLUSION

The panel judged that the master's programme Statistical Science for the Life and Behavioural Sciences offered by Leiden University meets all the standards of the NVAO assessment framework for limited programme assessment. The panel therefore gives a positive on the accreditation of the programme.

Conclusion

The panel assesses the *master's programme Statistical Science for the Life and Behavioural Sciences* as 'positive'.

APPENDICES

APPENDIX 1: INTENDED LEARNING OUTCOMES

Master's programme Statistical Science for the Life and Behavioural Sciences

A. Knowledge and understanding
The graduate has a broad knowledge of statistics and its role in science and society. This includes:

1. a firm grasp of the general concepts of statistical science and data science, with attention for the
1. differences in jargon in different contexts;
2. an understanding of statistical science as a branch of science and not merely a collection of techniques;
3. knowledge of relevant statistical / data science methods, their strengths, assumptions, and limitations;
4. deeper knowledge of statistical methods in specific chosen areas of application;
5. familiarity with directions of current research in statistical science and data science in specific chosen areas of application;
6. knowledge of planning and design of experiments;
7. knowledge of computing and data management;
8. knowledge of mathematical tools that are essential for statistics and data science (including basic calculus, linear algebra).

B. Application of knowledge and understanding
The graduate has the ability to apply his/her knowledge and understanding in a critical, creative, independent, and a systematic approach to model and evaluate complex phenomena arising in a variety of situations. This involves:

1. the choice of statistical / data science methods for data analysis in concrete applications;
2. working with imperfect data;
3. the translation between concrete applications and statistical terms;
4. the executing of tasks with appropriate methods;
5. the implementation of methods in computer programs.

c. Judgement and Evaluation
The graduate:

1. demonstrates the ability for sound statistical judgement both within a scientific and societal context;
1. is aware of the ethical implications of statistical studies;
2. has general insight in the value of science, its limitations, and its role in society.

D. Communication
The graduate is able:

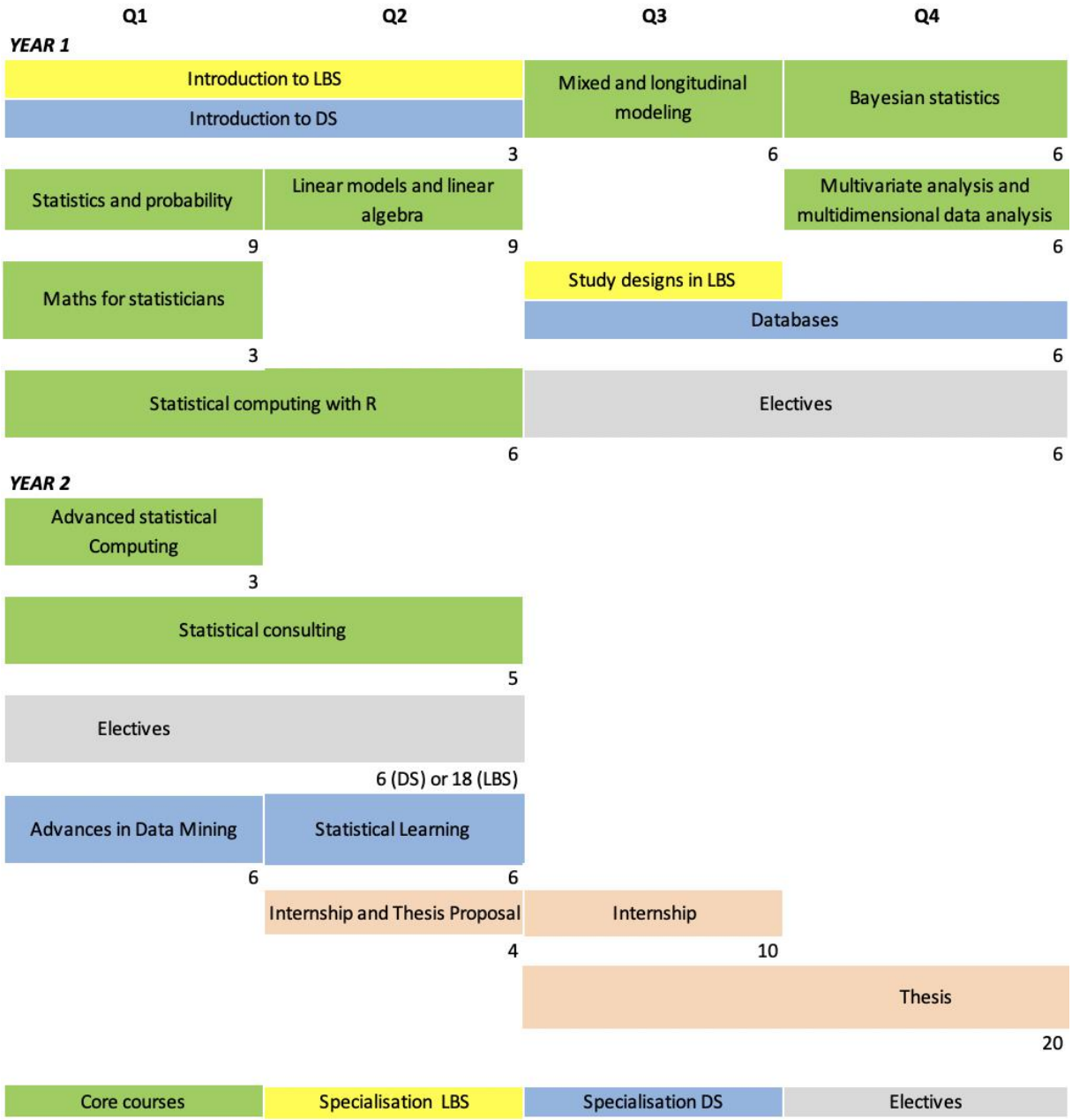
1. to explain the role of uncertainty in scientific discourse;
2. present and discuss, orally and/or in writing, the results of a statistical analysis, both to statisticians and non-statisticians;
3. engage in a dialogue with an applied researcher in a particular subject area with the purpose to identify and formulate research questions that can be dealt with by statistical analysis;
4. explain to substantive researchers the potential and limitations of statistical / data science methods.

E. Learning Skills
The graduate takes responsibility to develop his/her competence, and therefore, will be able to:

1. recognize gaps in his/her knowledge and to find the resources to fill these gaps;
2. find and consult appropriate sources in the international relevant scientific literature;
3. recognize a need for novel statistical and data science methods and contribute to their development or implementation;
4. plan tasks within a given period of time.

APPENDIX 2: OVERVIEW OF THE CURRICULUM

Master's programme Statistical Science for the Life and Behavioural Sciences



APPENDIX 3: PROGRAMME OF THE SITE VISIT

Monday 8 June

13.00 – 14.00	Preparatory meeting panel
14.00 – 14.30	Break / internal panel discussion
14.30 – 15.30	**Interview management**
14.00 – 14.30	Break / internal panel discussion
16.00 – 16.30	**Interview Board of Examiners**
16.30 – 17.00	Internal panel discussion

Tuesday 9 June

08.30 – 09.00	Internal panel discussion
09.00 - 10.00	**Interview Students + Alumni**
10.00 – 10.30	Break / internal panel discussion
10.30 - 11.30	**Interview Teaching Staff**
11.30 – 13.00	Lunch break / internal panel discussion
13.00 - 14.00	**Second interview management (including development dialogue)**
14.00 - 16.30	Concluding panel meeting
17.00 - 17.30	**Oral presentation**

APPENDIX 4: ADVICE ON PROPOSED NAME CHANGE

Leiden University
Attn. Executive Board

Advice name change master's programme Statistical Science for the Life and Behavioural Sciences

Dear members of the executive board,

On 8 and 9 June the assessment panel Statistical Science visited the master's programme Statistical Science for the Life and Behavioural Science at the Faculty of Science of Leiden University, with support provided by evaluation bureau QANU. The programme expressed the wish to change its name to 'Statistics and Data Science'. To support the request for a name change to the Dutch-Flemish Accreditation Organisation (NVAO), the panel was asked for advice on this topic.

During the site visit, the panel discussed the proposed name change with the programme's representatives. The wish for a name change results from the growing role of data science in the programme. Data Science is currently one of the two specializations of the programme. From the view of statisticians, data science is part of modern statistics, but is currently better recognized under its own name by students. In the planned curriculum update, the two specializations will be merged into a core curriculum that implements elements from both data science and more traditional statistics. The programme feels that 'Statistics and Data Science' reflects this core of the programme better than the current name. Furthermore, the new name is expected to be better recognizable, as well as shorter and more practical. There is no change in intended learning outcomes associated with the name change, and the programme will keep its orientation on the life and behavioural science as application domains. It will also continue its international orientation, and therefore keeps using an English name.

The panel agrees with the reasoning of the programme. It thinks that the English name 'Statistics and Data Science' better reflects the current and planned curriculum of the programme. Data science is not automatically assumed to be part of the field of statistics by students but is an increasingly large part of the programme. Making it explicit in the name better reflects the content of the programme to the outside world. The panel therefore concludes that the name 'Statistics & Data Science' is fitting with the aims and content of the programme, and judges positively on the proposed name change.

Best regards,

Prof. dr. E.C. Wit
Chair assessment panel Statistical Science

APPENDIX 5: THESES AND DOCUMENTS STUDIED BY THE PANEL

Prior to the site visit, the panel studied 15 theses of the master's programme Statistical Science for the Life and Behavioural Sciences. Information on the selected theses is available from QANU upon request.

During the site visit, the panel studied, among other things, the following documents (partly as hard copies, partly via the institute's electronic learning environment):

- All the 2019-20 StatSci Courses available on Blackboard;
- All year reports of the Programme, the Board of Examiners, and the Programme Committee;
- The minutes of the Board of Examiners (from 2018);
- The assessment of the Board of Examiners of the 2018-19 EXAMS of the Course Multivariate and Multidimensional Data Analysis;
- The minutes of the Programme Committee (from 2018-19);
- The 2019-20, and the available 2020-21 regulations;
- The results of the Nationale Studenten Enquete (NSE) and the yearly figures of the StatSci programme.