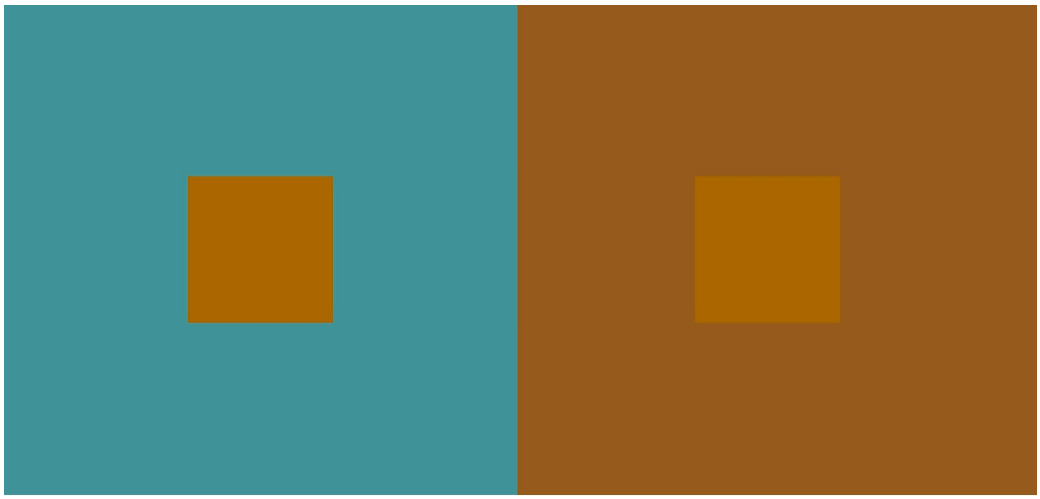
Research Evaluation Mathematics 2009 - 2014



Permission was obtained from the artist for the insertion of the picture on page 5.
©Teun Hocks , courtesy Torch Gallery Amsterdam
Zonder Titel, 2000
Olieverf op getinte zwart-wit foto , 129 x 172 cm.

Quality Assurance Netherlands Universities (QANU)
Catharijnesingel 56
PO Box 8035
3503 RA Utrecht
The Netherlands

Phone: +31 (0) 30 230 3100
E-mail: info@qanu.nl
Internet: www.qanu.nl

Project number: Q 0569

Report on the research evaluation of Mathematics in the Netherlands

Content

Preface

Before you lies the report giving the research evaluation of the mathematics research over the period 2009-2014 of nine Dutch universities according to the Standard Evaluation Protocol 2015-2021 adopted by the KNAW, the VSNU and NWO.

The assessment was performed by an Evaluation Committee consisting of a chairman, a secretary and 7 foreign members. The areas of expertise of the Evaluation Committee covered Algebra and Topology, Analysis, Applied Analysis, Dynamical Systems, Geometry, Numerical Analysis, Computational Science, Discrete Mathematics, Probability Theory and Statistics, Mathematical Physics, Systems and Control, Optimization, and Decision Theory.

The project started in the fall of 2014 with meetings of the prospective chairman with the Research Committee of Platform Wiskunde Nederland. One of the issues considered by this Committee was the issue of bibliometric analysis. It was decided that no bibliometric studies would be performed. It turned out that the members of the Evaluation Committee concurred with this decision, and bibliometric information played a minor role during the evaluation. On the issue of benchmarking, the PWN Research Committee decided to leave this out of the format for the self-evaluation report, with the argument that ample international benchmarking would take place by the seven members of the Evaluation Committee.

Information on the modus operandi of the Committee can be found Section 1 of this report.

The committee has been extremely well guided by dr. Meg van Bogaert, who acted as secretary and project manager. In name of all the Committee members I would like to thank her for her excellent support.

I would like to thank, also in name of the entire Dutch mathematical community, Regina Burachik, Alberto Cattaneo, Hans Künsch, Robert MacKay, Volker Mehrmann, Rolf Möhring, and Don Zagier for their tremendous effort.

Michel Dekking
Chair of the Committee

1. The evaluation committee and the review procedures

The Mathematics Evaluation Committee was appointed by the Executive Boards of University of Amsterdam (UvA), Vrije Universiteit Amsterdam (VU), Delft University of Technology (TUD), Eindhoven University of Technology (TU/e), University of Groningen (RUG), Leiden University (LEI), Radboud University Nijmegen (RU), University of Twente (UT) and Utrecht University (UU) to perform an assessment of the research in Mathematics at the aforementioned universities. The assessment covers the research that was conducted in the period 2009-2014, as well as the research strategies that were outlined for the upcoming period. In this sense the assessment was both retrospective and prospective.

In accordance with the Standard Evaluation Protocol 2015-2021 for Research Assessment in the Netherlands (SEP) and the Terms of Reference (ToR) specified by the participating universities, the committee's task was to assess the (1) academic quality, (2) societal relevance and (3) viability of the participating research units in relation to their strategic targets, and to advise on further improvements. Each of the three SEP criteria had to be scored against international standards by using a 4-point scale, ranging from 1 (excellent) to 4 (unsatisfactory). The SEP criteria and rating system are described in more detail in Appendix 2. The research programmes that are underlying the research units are assessed in a qualitative way, but conforming to the SEP 2015-2021 no scores were given to these research programmes.

Furthermore, SEP 2015-2021 instructs review committees to devote special attention to research integrity policies and the quality of PhD programmes, both at the level of the research unit.

Composition of the committee

The mathematics committee consisted of the following members:

- Professor R.S. Burachik, associate professor at the University of South Australia, Australia;
- Professor A.S. Cattaneo, professor at University of Zürich, Switzerland;
- Professor F.M. Dekking (chair), emeritus professor at Delft University of Technology;
- Professor H.R. Künsch, professor emeritus at ETH Zürich, Switzerland;
- Professor R.S. MacKay, professor at University of Warwick, United Kingdom;
- Professor V. Mehrmann, professor at TU Berlin, Germany;
- Professor R.H. Möhring, professor at TU Berlin, Germany;
- Professor D. Zagier, professor at Max Planck Institute for Mathematics, Bonn, Germany.

Short curricula vitae of the committee members are included in Appendix 1.

Dr. M.J.V. Van Bogaert of Quality Assurance Netherlands Universities (QANU) was appointed Secretary to the committee.

Independence

All members of the committee signed a statement of independence to safeguard that they would assess the quality of mathematics research units in an unbiased and independent way. Any existing personal or professional relationships between committee members and the programme under review were reported. The committee concluded that there were no

unacceptable relations or dependencies and that there was no specific risk in terms of bias or undue influence.

Data provided to the committee

The committee has received the self-evaluation reports of the universities under review, including all the information required by the Standard Evaluation Protocol (SEP), with appendices.

Procedures followed by the committee

The committee proceeded according to the Standard Evaluation Protocol 2015-2021 (SEP). Prior to the first committee meeting, all committee members independently formulated a preliminary assessment of a number of the units under review. The final assessments are based on the documentation provided by the universities as well as interviews with the management and representatives of each university. The interviews took place on 16-20 November 2015 (see the schedule in Appendix 3) in Amersfoort. Although the committee did not visited any of the nine universities, the meetings and interviews in Amersfoort are referred to as the *site visit* in this report.

Preceding the interviews, the committee was briefed by QANU about research assessment according to SEP, and the committee discussed the preliminary assessments and decided upon a number of comments and questions. The committee also agreed upon procedural matters and aspects of the assessment. After the interviews the committee discussed the assessments and comments. The final version was presented to the universities, for factual corrections and comments. The comments were discussed in the committee.

2. General remarks

Introduction
In this general chapter the committee provides a number of observations and opinions that are not related to a specific mathematics unit. The first part of this chapter concerns the assignment to the committee, the procedures that were followed and the evaluation protocol that was used. The second part of this chapter describes a number of findings and observations by the committee that cover the mathematics research in the Netherlands.

Some universities have an institute in which mathematics is organised; others have a department of mathematics. In the chapters in which the individual universities are evaluated (chapters 3-11) the committee adopted the organisational structure of the university. In this general chapter the committee uses the words 'institutes' and 'departments' interchangeably to refer to the unit of assessment.

Standard Evaluation Protocol
In contrast to the previous evaluations (evaluation report 2010), the present Standard Evaluation Protocol (SEP 2015 -2021) prescribes evaluations at the level of research units of at least 10 research fte excluding PhD students and postdocs. The result has been that all universities evaluated in this report have put forward one institute covering the entire research in mathematics. Even when combining all the research in mathematics, more than 50% of the universities did not manage to have a research institute of at least 10 research fte. Furthermore, the various sub-disciplines within each university are diverse in such a way that it is not possible to simply combine them, and give one assessment. This demonstrates the mismatch between SEP 2015-2021 and the mathematical discipline. The committee has decided to first evaluate the separated underlying research programmes before joining them into one integrated quantitative score.

A second important change in comparison to the previous evaluation protocol is that when referring to research quality, the rating scale ('quantitative assessment') has been condensed to a four-point scale, where the highest rating (1) reflects 'world leading/excellent', while the lowest rating (4) denotes 'unsatisfactory'. According to the committee practically all Dutch mathematical research is internationally recognised and therefore the rating 'good' (3) would do no justice to the level at which research is performed. Effectively therefore, the four-point scale is reduced to a two-point scale since .5 scores were explicitly not allowed. The committee mentions yet another consequence of the 2015-2021 protocol. Rating an institute of 25 researchers is not a matter of taking an average score over these 25 individuals. When just a few of these are absolutely world-leading, this could result in the rating (1) for the whole institute. This all leads to a quantitative rating that is too coarse to reflect the differences that exist between the universities or between programmes within an institute. As a result, the narrative descriptions in this report should be seen as considerably more informative than the quantitative scores.

SEP 2015-2021 dictates that the self-evaluation reports should not exceed the total of 15 pages (excluding tables). Almost all universities exceeded the number of pages, or included lengthy appendices. Of course, the committee understands that exceeding the limit easily occurs in order to provide in-depth information on research contributions. Even so, this in-depth information often still provided insufficient information on the actual research that was done at the departments. The committee found very useful, however, the short narratives a

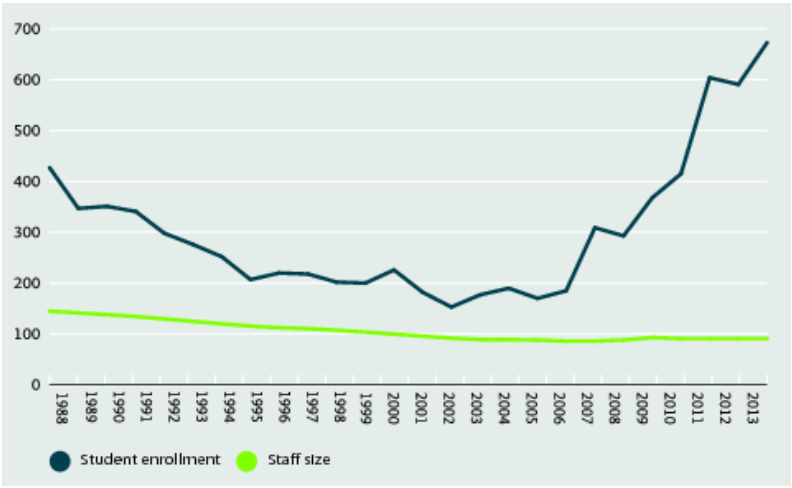
few institutes provided on their 15 highlighted publications or on selected projects of societal relevance.

Despite the best efforts of the universities supplying the information, comparability (specifically of the quantitative information in the tables) turned out to be a major challenge. Universities did not always use the same criteria; for example, not all included scholarship students as an independent group. It also turned out to be impossible to compare percentages of direct funding, grants and contract funding. Some universities have a monopoly in mathematics service teaching for the entire university, which leads to huge amounts of direct funding to compensate the teaching input. However, this leads to a distorted ratio between direct funding and indirect funding. Hence the committee had to rely to a substantial extent on the information collected during the site visits, in particular information reflecting strategies and policies aimed at quality maintenance and improvement.

Overall assessment of research quality

The committee believes the research in mathematics in the Netherlands to be of very high quality, and in a number of cases even excellent. In general the research finds its way to top level international journals, with exception of some of the very applied research.

The single most prominent fact about the development of mathematics at Dutch universities during the last 12 years is that there has been a dramatic and most welcome upswing in the numbers of beginning students since the catastrophic decline in the years 1988-2003. However, there has not been a corresponding increase in the number of staff members, which in some cases continued to be cut long after the low enrolment numbers might have justified this. One has to realize that the figure below does not tell the whole story: the student enrolment refers to mathematics students, but since there has also been an increase of students in other disciplines, the service teaching load is also much heavier.



Staff size is measured in

The result is an increased workload, an undue financial pressure and pressure on getting grants, and as a consequence a less attractive environment for young researchers that in the long run will inevitably decrease the ability of the Netherlands to continue to attract top talent from abroad. This problem is crucial, and despite the still excellent level of Dutch university mathematics as a whole, potentially devastating. It is of course being discussed at many levels, from individual departments to faculties to boards to national initiatives (Deltaplan), but it cannot be emphasised enough how important it is that these efforts continue and are taken seriously at both the university and the national level.

Societal relevance
On the whole, Dutch mathematics is making an excellent contribution to society, not just for its intellectual value, the training of students in valuable mathematical methods and public engagement, but also in direct research projects in a diverse range of areas such as water management, medical imaging, electric power distribution, healthcare planning, forensic science, and the development of software. Although a balance is necessary between doing mathematical research for its own sake and for applications, there are more opportunities that Dutch mathematics could take. In particular, some institutions view the shift in funding regime towards application-driven research as a threat, whereas others view it as an opportunity. This is particularly true of the Top-sectors, to which a separate section is devoted below.

On a general level the importance of mathematics as the language of science cannot be overestimated. Furthermore in almost all key technologies the impact of mathematics, in particular mathematical modelling, simulation and optimization is huge, but not sufficiently recognized by society. Mathematics acts as a transversal science, results can be transferred from one field to another once the appropriate abstraction level has been reached and the language barriers are broken. This is prominently visible in the technical universities but also to a large extent in every single department under evaluation.

In previous years large efforts have been made to increase the visibility of mathematics for other sciences and society. But more efforts are needed in this respect to make the societal relevance obvious. Mathematical research needs to be incorporated and funded within funding programs for all technology areas, in particular the Top-sectors.

Funding
As mentioned earlier it was impossible for the committee to compare institutes based on the quantitative information that was provided in the self-evaluation reports. Direct funding strongly depends on the amount of service teaching that is done by the departments. Some mathematical departments do all service teaching in mathematics at their university, while others have very limited service teaching. The committee therefore did not use percentages of the funding streams, but did look at absolute grant income and contract research in combination with the size of the staff.

Many of the research institutes that were assessed are (or have been) shifting focus from predominantly national grant applications at NWO to international grant opportunities. These are often larger grants and, similarly to national grants, very difficult to obtain. According to the committee, initiatives like 3TU.AMI can be valuable in the application of these large, international grants.

The committee observed professionalization of the funding acquisition process. All universities have a support office at central university level that supports the grant application procedure. A number of universities also provide support at faculty level. The committee concluded that a better understanding of the specific situation for mathematics of the supporting staff leads to better support and more success in grant applications. The support office that was most specifically targeted at mathematics, PDO in Eindhoven, deserves to be mentioned as best practice. The PDO support staff selects appropriate calls for mathematicians from the large amount of calls that are available. It furthermore supports scientific staff to apply, and executes a lot of the procedural activities. In the evaluation period this support has led to a high success rate in grant applications, and it seems worth the investment.

Top-sectors
The Dutch Top-sectors programme with its focus on research in themes and on short-term valorisation makes it difficult for mathematics to have a leading role. Some of the institutes engage well already with the Top-sectors, while others have more difficulties to find the right approach. However, mathematics is a fundamental requirement in all Top-sectors, and although it might not be the primary objective of many projects, mathematicians should claim their crucial role in the applications and projects. The committee therefore considers that Dutch mathematicians should try to join forces with other disciplines with whom they cooperate and become involved as partners in Top-sector projects. For instance, Logistics, Life sciences and Health, High Tech Systems and Materials, Energy, and Water offer opportunities to become an active player. At the same time, mathematicians should try together with other areas of fundamental research to lobby against further reduction of funds for basic research. The arguments will become stronger if one can point out that mathematics is involved in some Top-sector projects.

Hiring strategy: recruiting and retention
At many universities the hiring strategy focuses on excellence in research quality of the individual candidate rather than an exact match of the expertise within a research group. The university that most convincingly takes this approach, and is successful in this, is Leiden University. Other universities are also taking this approach more often and seem successful. The balance between this strategy and coherence of the departmental research topics should always be considered. If this is the case, the strategy could be very successful.

A drawback of the focus on excellence is a retention problem. The committee has observed that during the assessment period quite a few of the top researchers have moved at least once. Institutes that have put an effort to put themselves on the map in a certain area then are often forced to change their strategy.

Tenure-track policy
As can be read in the assessments for the different universities, all institutes have a tenure-track policy in place. The committee considers tenure-track essential for Dutch mathematics, in order to attract young, talented mathematicians and compete with foreign research institutes and universities. The basis of the tenure-track strategy is similar for all universities; an assistant professor temporary contract is given to the researcher for a certain period (4-6 years) in which the tenure-tracker can develop and display their ability in doing high quality research, teaching and grant applications. When complying with the criteria that were set at the beginning of the tenure-track, a tenure position is guaranteed. The execution of the tenure-track strategy differs between the universities. The two predominant differences that are observed might affect the attractiveness of tenure-track positions between universities.

The first is the support given to the tenure-tracker at the beginning of the contract. All universities aim to provide the tenure-tracker with a PhD student to supervise. However, not all universities can make use of direct funding to pay for this PhD student. This could lead to either not being able to provide a PhD student to a tenure-tracker, or providing one that is paid for by grant funding. This latter is preferred to not having a PhD student at all, but nevertheless might lead to a PhD student with a research topic that is not closely related to that of the tenure-tracker. The committee highly appreciates the universities that make available direct funding for PhD students.

The second difference that is observed is the way departments are allowed to adapt the criteria for tenure to the specific situation of mathematics. This predominantly is important

for the success in grant applications. In areas like mathematics, chances to obtain grants may be much lower compared to other disciplines within the faculty, owing to less funding being available. Many universities in the Netherlands consider writing a proposal that has received a very good evaluation by the reviewers to be sufficient for the criterion grant applications, even if the grant itself was denied. In some universities this is currently not the case, and at one university this has already led to denying tenure to an otherwise highly performing tenure tracker.

A third difference is the application of the ius promovendi. Most universities only have ius promovendi at full professor level, while some universities grant the ius promovendi at the associate level.

At all Dutch universities a tenure-track position, when complying with the set criteria, guarantees a tenure position. All departments stated that there is no competition for one tenure position between a number of tenure-trackers who satisfy the criteria.

Diversity
More proactive efforts should be made to acquire female mathematicians at all levels (tenure track, associate professor, full professor). The record of Dutch mathematics in this respect was dismal, and although some progress has been made, it is not even close to sufficient, nor at all commensurable with the efforts being made and the success being attained in neighbouring countries. The claim that is occasionally still, made that there are almost no equally qualified female candidates is simply no longer true, although the numbers are still much smaller than for male candidates and one therefore has to try harder. What is true is that, because of the imbalance on the supply side and the fact that universities everywhere are trying to improve their profile in this respect, it is often difficult to get an excellent female researcher, even if one makes a good offer. Each department should therefore seriously think about ways to make offers that are particularly attractive, especially for young people and with respect to the probability of acquiring tenure. Some departments or faculties (or universities) have set aside funds specifically for hiring of female candidates, and although it is to be hoped that such measures will not be necessary in a few years, given the present situation and the necessity of changing the current negative perception of the academic world of female researchers starting their careers, such initiatives should be welcomed and encouraged.

Research integrity
Infringement of research integrity and fraud are very uncommon in mathematics. Nevertheless, the committee considers it to be very important that not only there is policy at university level, but also specific policy with respect to mathematics. There are two levels of research integrity, that of general science, and that of the discipline of mathematics. It would make sense according to the committee that all institutes would agree on choosing the same code of conduct at these two levels. For the first level this could be the VSNU "Netherlands Code of Conduct for Scientific Practice", for the second the code of conduct of the European Mathematical Society. At the moment some research units employ other codes of conduct.

Also, the policies should be actively communicated to staff, specifically to PhD students and undergraduate students. This seems to be the case. It was, however, difficult for the committee to assess the effectiveness of any of the policies. All universities stated in their self-evaluation report that no misconduct or infringement of research integrity occurred during the evaluation period.

In some areas of applied mathematics, reproducibility of numerical experiments and statistical analysis is a key aspect of research integrity. This requires a policy for the storage of data and for making computer code publicly available, and it would be desirable to have a common set of rules for this too.

PhD training

Without exception the committee was very impressed by the quality of the PhD training and supervision. PhD students are encouraged to visit other researchers (internationally), attend conferences and summer/winter schools. Another positive point is the Dutch custom that there is always an international committee assessing and ensuring the quality of the thesis, giving an international accent to the work of the PhD student. The committee compared quality of PhD training with foreign universities for which it knows the situation and considers the Netherlands to have a very high quality of PhD training.

All PhD students have the opportunity to follow courses on topics that help them in their research. Often these are Mastermath courses, and usually the supervisor advises the PhD students on which courses to follow. In addition, many departments offer a number of compulsory courses in general skills, like presenting and scientific writing. There is a tendency to organise the PhD training in graduate schools. These graduate schools allow for a more organised training of general skills, while also providing individual PhD students to follow courses within their own discipline.

Most universities assign the primary responsibility for PhD training to the supervisors. This makes the individual supervision very important, but also allows for a tailor-made training. With projects from different funding bodies, different duration of the projects and different requirements between for example regular and scholarship PhD students, it is very difficult to set up one training for all PhD students at one university, The committee considers the supervision of high quality and is supportive of the individual training programmes as long as it allows PhD students to graduate within time and with high quality research. In case of low graduation rates, high dropout numbers or other problems, the committee noticed that adequate action was taken. This action often resulted in less freedom for individual students, while providing the structure that was required to improve the situation. One example is the way a department makes use of the go/no-go decision. According to the committee, this decision moment should always have a formal character, and provides an excellent tool to enforce structure in a department in need of it. In practice this might of course be handled informally.

A third activity, next to doing research and training, is teaching. Most PhD students are involved in teaching activities in undergraduate courses, mainly exercise classes. All claimed to enjoy teaching and to value the experience. Although the amount of teaching required varied between universities, it was always acceptable and within the limits of the contract.

Data Science centres

In view of the huge importance of data driven research for the further development of science and technology, data science centres are being set up at most universities. The committee thinks that this offers many opportunities for mathematics since research in data science raises interesting new questions for statistics and optimization. It is therefore essential that mathematics institutes play an active part in such centres. An especially well advanced activity was observed at TU/e, where the mathematics institute has taken a leading role.

4. Research evaluation Department of Mathematics, Vrije Universiteit Amsterdam

4.1 Organisation, leadership, strategy and targets of the research unit

The Department of Mathematics is responsible for the research in mathematics at the Vrije Universiteit Amsterdam (VU). It is part of the Faculty of Sciences (FEW), for which it also provides mathematical courses, and is closely linked to the Faculty of Earth and Life Sciences (FALW) and Faculty of Economic Sciences (FEWEB) at the VU. Its research policy is directed towards finding a balance between applications and the fundamentals of mathematics. This policy has led to a department in which dynamical systems and stochastics (statistics, probability theory, and business analytics) are especially well represented. Many of the researchers are active in multiple themes and the themes have overlap with multiple mathematical disciplines. The department distinguishes the following themes and sub-themes:

- Biomathematics: brain imaging, mathematical biology, population dynamics, statistical genomics, statistics for neuroscience, systems biology;
- Business Analytics: call centres, E-health, health care logistics, operations research, optimization of business processes, queuing theory, statistics;
- Determinism and Randomness: dynamical systems, probability theory, random processes, statistical physics, statistics, stochastic differential equations, forensic science, philosophy, partial differential equations (PDE's);
- Geometric Dynamics: Morse-Conley-Floer theory, percolation, spatial probability, symmetries in dynamical systems, symplectic geometry, variational methods;
- Modelling and Statistics: Bayesian inference, control theory, forensic stochastics, industrial mathematics, mathematical physics, partial differential equations, statistical models;
- Patterns in Complex Systems: coupled cell networks, dynamics in biological networks, high-dimensional statistics, large systems of nonlinear differential equations;
- Shape and Structure: algebraic K-theory, arithmetic geometry, convex geometry, homotopy theory, number theory, symplectic topology, toric topology.

The mission statement of the Department of Mathematics is two-tiered: to perform research on the frontier of mathematical knowledge, motivated by scientific and societal questions and needs, yet emphatically including a fundamental component. Where possible, the department aims for research on the crossroads of fundamental mathematical results and practical questions, exploiting the interplay between theory and applications. It has formulated two research objectives:

- Perform high-quality mathematical research resulting in publications in outstanding international journals.
- Carry out applied mathematical research that is highly relevant to other disciplines and/or society.

The department aims at a balance in staff between fundamental and applied mathematics. Staff members have full freedom to choose their research topics. Diversity in research topics is important, while at the same time a certain focus is aimed for, in order not to spread too thinly on specific themes. This has consequences for the type of researchers that are hired.

The department takes part in the NWO clusters WONDER and DISC, Amsterdam Data Science, an initiative of the UvA, VU, CWI, and Hogeschool van Amsterdam that brings together leading researchers in data science. It participated in the European collaboration programme CAST (Contact and Symplectic Topology) as an associate member. Research partnerships are almost exclusively based on individual contacts, both within the VU, and nationally and internationally. The department has research contacts with essentially all other mathematics departments in the Netherlands, and with numerous institutes around the world.

The intended merger between UvA and VU was blocked in 2013 and led to a new, bottom-up approach in the science domain. It includes possibilities to intensify and strengthen the collaboration with the Korteweg-de Vries Institute (KdVI) and the Institute for Logic, Language and Computation (ILLC) at the UvA. The committee intensively discussed the consequences of this failed merger, which is clearly a setback for organisation and management of the mathematics departments at both universities. The universities have put both mathematical departments in an unfortunate limbo, unsettling the mathematicians by first proposing a merger and then not continuing with it. Nevertheless, the departments have to find a way to deal with it.

Regarding this merger, the same comments the committee made for KdVI are in order, these comments are recalled here for the reader's convenience. The Dean expressed clearly that currently a bottom-up approach is in place for all disciplines at both Faculties and the onus is on departments at each to explore ideas for collaboration. Some departments apparently are actively seeking collaboration both in research and in education. In mathematics, however, discussions on collaboration at the departmental level are limited to education, though there are informal interactions in research areas like dynamical systems and even a joint appointment. Although mathematics, unlike for example physics, does not need an expensive infrastructure that could profit from joint initiatives between VU and UvA, the committee was disappointed that no efforts seem to be being made in the direction of a combined strategy in mathematical research. This could turn out to be dangerous since other departments within the same faculties are actively pursuing joint research activities and the bottom-up strategy may be abandoned at some point if it does not produce results in Mathematics; it may be replaced by a top-down one which might not take into account the views of the mathematicians. On the other hand, there is a strong ongoing collaboration with the department of econometrics and computer science that has a strong influence on the bachelor curriculum and training. Concerning research, there are joint activities in the direction of business analytics.

Based on the current assessment the committee concludes that both departments do very good research and each has its own strengths. A merger might not strengthen the research in mathematics and could lead to counter-productive disruption. However, the two departments should make an effort to emphasize the fact that they are complementary in many respects, which is currently not clear to an outsider. At the same time a search for common research topics in which synergy can be obtained should also be started. The committee has seen some good examples of this and strongly encourages the departments to continue in a more structured way. The committee recommends that the departments do not sit back and wait, but actively participate in the bottom-up approach instigated by the Dean.

Resources

In the period of assessment the number of scientific staff members (tenured and tenure track) of the Analysis, Algebra and Geometry programme decreased from 15 to 11, while the number of PhD students increased from 8 to 11. The number of scientific staff members

(tenured and tenure track) in Stochastics decreased from 17 to 15, while the number of PhD candidates decreased from 16 to 11.

The majority of the staff members are tenured. Roughly 10% of the budget is reserved for flexible decisions whenever needed or wanted, such as employing temporary staff members and allowing young staff members, like tenure trackers, to hire (and supervise) a PhD candidate. The department has four tenure-track researchers, for whom the tenure conditions have been clearly formulated.

The committee supports the tenure-track policy in which young, talented researchers get the opportunity to do research and develop a research group within their expertise. The committee is very positive on the flexible budget that the department uses to support tenure trackers and the policy of giving them a PhD student to supervise. Requirements for tenure are on teaching, research and grant acquiring. The committee applauds the fact that VU provides each tenure tracker with a PhD student to supervise within his/her own area of expertise. This displays support by the VU to the tenure tracker, for whom the PhD student provides support in doing research, developing an academic track record and writing grant proposals. The committee is also very positive regarding the way criteria for tenure are adapted to the discipline. In mathematics it is extremely difficult to obtain grants from (inter)national research councils. Even when a proposal is rated as very good by all assessors, obtaining the grant is not a certainty. The committee agrees with the VU department in mathematics that a very good assessment of a grant application should allow for granting tenure, even if the grant itself was denied. Concluding, the committee compliments the department on their policy regarding tenure track.

The department depends predominantly on direct funding. Next to its direct funding, the department obtained a number of grants. A large number of PhD candidates are paid by industry through the Business Analytics programme. In the near future, the department wants to put more emphasis on European grants.

Total funding has decreased 700 k EUR between 2009 and 2014, mainly due to a decrease in direct funding and fluctuating funding in research grants. The decrease in direct funding is a consequence of cuts in national funding and reduced student numbers at university level. This is considered a problem, since student numbers in mathematics are increasing.

4.2. Assessment of the SEP Criteria

Introduction

The Analysis, Algebra and Geometry (AAG) research programme consists of two research groups: Analysis and Dynamics and Algebra, Geometry and Topology. In 2014 the research programme included 11 scientific staff members, 2 postdocs and 11 PhD candidates with a total of 13.7 research capacity in fulltime equivalents.

The Stochastics research programme consists of three research groups, Probability Theory, Statistics and Business Analytics. In 2014 the research programme included 15 scientific staff members, 3 postdocs and 11 PhD students with a total of 6 research fte in fulltime equivalents.

Research quality

The VU department in mathematics clearly changed its organisation and focus from mathematical topics towards research themes. The committee tried to focus on both aspects.

On the one hand the thematic approach seems to be a very good basis for collaboration across groups and indeed this was observed in the outcomes of research. On the other hand, to be able to assess the quality of the programmes, the committee focussed on mathematical topics.

Six years ago there were three research programmes in mathematics at the VU. The AAG programme is the result of the merger of two of these programmes, namely Analysis & Dynamics and Algebra, Geometry & Topology. This merger makes sense because the Algebra, Geometry & Topology group has shrunk drastically over the period and was probably no longer viable on its own, and a significant part of the research of the dynamical systems team is oriented to geometry (symplectic), topology (braids, homotopy), or algebra (symmetries); furthermore the work in linear algebra is oriented to dynamics. The quality of the research in dynamical systems is excellent. A question remains, however, how well integrated the remaining algebraists and number theorists are. They are doing good work, but appear to be singletons in the department.

The Stochastics programme has lost a world-leading scientist to another university. The programme was able to replace him with a very good successor in a similar area. Moreover, the programme has consolidated its strength in applied areas, namely queuing theory and business analytics on the one hand and statistics in life science, in particular neuroscience and forensic statistics, on the other. The members of the programme are closely collaborating with researchers from these areas. In addition, there is a very good small group in statistical physics with important publications on properties of the Ising model. The committee had some questions about the strategy of the group in view of the diversity of the topics. However, there are members who actively bridge different topics and thus prevent fragmentation. Overall, the research is of very high quality with internationally well recognised senior researchers, a number of tenured junior staff and two tenure-track assistant professors who started recently.

Relevance to society

The department made a strong effort in outreach and working with other fields. This is made visible by the change in strategy from mathematical topics towards research themes bridging disciplines. The themes the programme is now focused on (for example business analytics) certainly have high impact in economics and other areas; these activities are justly listed as a strength. Many publications are joint with researchers from other disciplines. In these disciplines it would be difficult for a mathematician to publish on his/her own. One example is the work modelling glycolysis in which a dynamical systems analysis has explained a fundamental bi-stability of cells between the normal state and one in which glucose is consumed continuously but very little ATP is produced. Another example is the large number of publications in medical and bioinformatics journals with co-authors from the Stochastics group.

Both programmes are explicitly focussing on societal relevance in addition to high quality research. The committee has observed a number of excellent efforts that indeed have led to societal impact. Examples are systems biology, forensic statistics, neuroscience, operations research and business analytics. Concerning the latter, the department is co-founder of the Patient flow Improvement Centre Amsterdam (PICA) and of the Amsterdam Centre for Business Analytics.

In conclusion, the committee was very impressed by the efforts of the department regarding societal relevance and the results that were described in the self-evaluation report.

Viability

The SWOT analysis of VU touches upon a number of topics that were also observed by the committee. Some of these topics lie outside the scope of the department to influence, others could and should be dealt with at the level of the department or Faculty. Although difficult to support with clear examples, the committee considers that the department has more strengths than they seem to be making use of. In a way, they are underselling themselves.

Furthermore, the situation of the abandoned merger with the UvA has its effects on the future of the department. Although the department can be proactive in dealing with this situation, it is also dependent on the Boards of the universities.

The committee compliments the department on their tenure-track strategy. They provide tenure trackers with a PhD student as a starting position, putting them in an excellent position to fulfil the tenure criteria. In the long run this approach is expected to give them an advantage and is well worth the investment of a PhD student on direct funding.

Finally, a general challenge for the future is the teaching. According to the discussion during the site visit, teaching is being paid fairly at VU. This is beneficial for the mathematicians that have to teach the strongly increasing number of undergraduate students. This also leads to the fact that other faculties at VU decide not to ask the department of mathematics to do service teaching, they consider it financially more beneficial to do mathematics teaching themselves. The committee agrees with the department that mathematics is best taught by mathematicians, to assure a certain quality. The recommendation to the Board of the University is to investigate in what way the mathematics department can be facilitated to be more involved in the teaching of mathematics at other departments.

Overall the viability is considered to be very good. The AAG programme made a strategy; the plan is to focus on certain areas, discard other areas and look for collaboration in areas where the programme is small. The small number of PhD students should be dealt with. Although the committee agrees that the intensive supervision of PhD students in mathematics does not allow the number of PhD students per tenured staff member to be as high compared to other disciplines, the number in this department is too low compared to mathematics departments in the Netherlands generally.

The viability of the Stochastics programme is considered to be very good. The group has a good size and covers a wide range of topics. With its strength in applied areas it is in an excellent position to play a leading role in the Amsterdam Data Science initiative and to be successful in acquiring research funds. The group has hired a number of young, talented staff to go forward and develop further.

Conclusion

The mathematics department at Vrije Universiteit Amsterdam has a number of strengths and challenges. The quality of the research is very good, although for some topics the department is spread rather thinly. The department actively focuses on societal relevance and effects of this policy are clearly visible.

The viability is very good for both programmes. The committee is convinced that the department should actively look for ways to connect with the UvA where synergy and strengths can be gained, and at the same time develop its own distinguishing features.

4.3. PhD programmes

Between 2004 and 2010, 54 PhD candidates enrolled in the Department of Mathematics, of whom 48 candidates graduated and 6 are not yet finished. Of the total number of graduates (48), 36 completed their PhD within four years, 11 within five years and 1 within six years.

All PhD candidates work within the national research school WONDER, and they are all connected to one of the national research clusters. According to the VU, the quality of the PhD candidates is foremost guaranteed by the selection procedure. The department allows the best students to proceed in a PhD programme and it solely relies on the knowledge of the individual researchers to select only the best candidates. Most of the candidates publish articles in international refereed journals throughout their PhD period. Candidates initially have a one-year contract, after which they are evaluated. It rarely happens that the contract is terminated after this first year. In most cases, the candidate receives a contract for the remaining three years of the PhD programme.

Like all PhD programmes in the Netherlands the department at the VU is doing very well in training and supervising its PhD students. The fact that none of the PhD students dropped out and completion of the projects is nearly always within the five years, seems to confirm the strategy of hiring the best candidates. When asked their impression on the supervision, students were very positive and all have regular meetings with their supervisors. The committee is positive about the fact the each PhD student has two supervisors.

Although there are no formal courses to be followed, the close supervision of PhD students assures that courses are followed when this is considered useful for the progress of the project. Most PhD students attended a number of conferences.

All PhD students are required to be involved in teaching. Officially this is 20% of their contract, but in reality it is considerably less. They spend approximately one day a week on teaching when they are involved in exercise classes, but they are not involved throughout the entire year.

4.4. Research integrity policy

The VU adheres to the principles of the Netherlands Code of Conduct for Scientific Practice as laid down by the VSNU and the Code of Practice of the European Mathematical Society. Furthermore, the VU secures the right to complain if university employees breach academic integrity or are suspected of doing so. This right has been laid down in the VU-VUMC Academic integrity complaints regulation (July 2014). The policy of the department is directed to further strengthen the university's principles and standards by making explicit what research integrity means in the context of mathematics. The most important factors of research integrity are awareness, openness and discussion. Students are being educated in line with the culture and tradition of the department to uphold the standards of ethical behaviour, particularly in relation to the public and dissemination of mathematical research.

As mentioned in the general chapter of this report, infringement of research integrity and fraud are very uncommon in mathematics. Nevertheless, the committee approves that the department has a policy and is actively communicating this policy to its staff, and specifically to PhD students and undergraduate students.

4.5. Recommendations

General recommendations

- The department should take a more pro-active approach to the opportunities for research in the Top-sectors, in particular in Life Science and Health where they have already good connections with researchers from these disciplines.
- The department should strengthen collaboration with mathematics at the KdVI, make a joint plan on how to continue. This could for example be done by a joint research strategy. This strategy could consist in agreeing to develop in complementary areas, thus requiring very little coordination beyond a non-competition agreement. However, for dynamical systems and in statistics, that are topics of both universities, it would make more sense to plan cooperation agreements. Also, the strategy can build on the collaboration in education, by joint PhD projects and joint degrees. Some incipient signs of research collaboration already exist, such as joint UvA-VU PhD projects mentioned in one of the self-evaluation reports.
- Business analytics as a mathematical theme is very promising and should be fostered. The already ongoing cooperation with econometrics may give it an additional stimulus with good chances to increase the outreach.

Recommendations to Analysis, Algebra & Geometry:

- This programme needs to assess the viability of its small part in algebra and number theory. Now the programme is predominantly in Dynamical Systems, albeit with strong geometric, topological and algebraic strands. There is a case, however, for strengthening the group in algebra and number theory.
- The programme could take more opportunities in the direction of applications of dynamical systems to societal relevance.
- It would make sense for the dynamical systems group to plan a formal cooperation with that at the University of Amsterdam.

Recommendations to Stochastics

- The programme is recommended to develop a strategy to obtain a leading position in the Amsterdam Data Science initiative.
- The programme has an excellent position to become a partner in an application for a big multidisciplinary research grant in life sciences or management sciences.
- The programme is recommended to strengthen the interactions between more theoretical and more applied research lines in the programme.

4.6. Qualitative assessment

Research quality	very good
Relevance to society	excellent
Viability	very good

Appendices

Appendix 1: Curricula Vitae of the committee members

Regina Burachik received her BSc and MSc in pure Mathematics in 1987 at the Universidad de Buenos Aires (UBA). In 1995 she obtained her PhD in Mathematics at the Instituto Nacional de Matematics Pura e Aplicada (IMPA) in Brazil. At present she is associate professor at University of South Australia, at the School of Information Technology and Mathematical Sciences. Her research interests are Smooth and Nonsmooth Optimization, Multiobjective Optimization, Convex Analysis and Variational Analysis. She is supervising seven PhD students in nonsmooth optimization as well as co-supervising a joint PhD student with the University of Newcastle. She is member of the Editorial Board of a number of international journals and in addition wrote 55 refereed articles, she published 4 scholarly book chapters and is guest editor of 7 special issues for renowned publishers and international journals. She holds a patent on 'method for performing intensity-modulated ion therapy so as to selection treatment plan satisfying prescribed dose treatment criteria'.

Alberto Cattaneo obtained his degree (1991) and his Ph.D. (1995) in Physics at the University of Milan. He was a postdoc at Harvard University and at Milan University. He was appointed Assistant Professor in Mathematics at the University of Zurich in 1998 and since 2003 he is Full Professor in Mathematics. He is currently director of the Institute of Mathematics. His fields of interest are in mathematical physics, differential geometry and algebraic topology; in particular, his research activity includes deformation quantization, symplectic and Poisson geometry, topological quantum field theories, and the mathematical aspects of perturbative quantization of gauge theories. He has been a long term visitor at the University of Nantes, at Harvard University, at IHES and at UC Berkeley. He was an ICM speaker (Section Mathematical Physics) in 2006 and is a Fellow of the American Mathematical Society.

F. Michel Dekking (chair) received his diploma in Mathematics and Mechanics in 1974 at the University of Amsterdam. He was Attachée de Recherche, C.N.R.S. at the Université de Rennes, during 1975-1977. He received his Ph.D. degree at the University of Nijmegen in 1980, with advisors M. S. Keane and W. Vervaat. Since September 1981 he is affiliated to Delft University of Technology, were he is now Professor emeritus. He is active in diverse areas of pure and applied mathematics. In 2013, he was guest editor of the special issue on "Mathematics of Planet Earth" of Statistical Science.

Hans Rudolf Künsch obtained his Diploma in 1975 and his PhD in 1980 from ETH Zurich. After a postdoc position at the University of Tokyo he became assistant professor at the department of mathematics at ETH Zurich in 1983. In 1989 he was promoted to associate professor and in 1992 to full professor. His research interests are in the field of statistics and include the modeling and analysis of time series and spatial data, resampling methods, filtering problems and applications in environmental sciences. He was co-editor of the Annals of Statistics 1998-2000. From 2007 to 2009 he has chaired the department of mathematics at ETH, and in 2012/13 he was president of the Institute of Mathematical Statistics (IMS). He is an elected member of the International Statistical Institute and a Fellow of IMS. Since summer 2014 he is retired as professor at ETH, but he continues his scientific activities.

Robert MacKay is a professor in the Mathematics Institute of the University of Warwick and Director of the Centre for Complexity Science and of Mathematical Interdisciplinary Research at Warwick. He was President of the (UK) Institute of Mathematics and its

Applications for 2012-13. He has made many contributions to the theory and applications of Nonlinear Dynamics. His research was recognised by the first Stephanos Pnevmatikos International Award for Research in Nonlinear Phenomena (1993), a Junior (1994) and Senior (2015) Whitehead prize of the London Mathematical Society, election to Fellowships of the Royal Society (2000), the (UK) Institute of Physics (2000) and the (UK) Institute for Mathematics and its Applications (2003), entry to the ISI Highly cited list under Mathematics in 2008, a Royal Society Wolfson Research Merit Award (2012-7), and a Renowned Fellowship of EPSRC Recognising Influential Scientists and Engineers (2014). He has published 135 refereed journal articles, 50 articles in conference proceedings, lecture notes and similar, written 1 book and co-edited 1 reprint selection, 2 volumes of lecture notes and 4 conference proceedings. He has experience of evaluation in academia, notably having served on the Applied Maths panel of RAE2001 and 2008, research grant panels in the UK, EC and Netherlands, research evaluations in France, and advisory boards in the UK and France, examination boards in Warwick and Cambridge, and responded to government and other consultations as President of the IMA. He has designed and tested a method for calibrating panel assessments.

Volker Mehrmann received his Diploma in mathematics in 1979, his Ph.D. in 1982, and his habilitation in 1987 from the University of Bielefeld, Germany. He spent research years at Kent State University in 1979--1980, at the University of Wisconsin in 1984--1985, and at IBM Research Center in Heidelberg in 1988-989. After spending the years 1990-1992 as a visiting full professor at the RWTH Aachen, he was a full professor at TU Chemnitz from 1993 to 2000. Since then he has been a full professor for Mathematics at TU Berlin. He is a member of acatech (the German academy of engineering) and vice president of GAMM the (International association of Applied Mathematics and Mechanics), chair of MATHEON, theResearch Center `Mathematics for key technologies´ and vice chair of the Einstein Center ECMath in Berlin. He is Einstein Fellow, holds an ERC Advanced Grant and also was member of the ERC Panel PE1. He is editor of several journals, editor-in-chief of Linear Algebra and its Applications. His research interests are in the areas of numerical mathematics/scientific computing, applied and numerical linear algebra, control theory, and the theory and numerical solution of differential-algebraic equations.

Rolf H. Möhring obtained his M.S. (1973) and P.h.D (1975) in Mathematics at the RWTH Aachen and is since 1987 Professor for Applied Mathematics and Computer Science at Berlin University of Technology, where he heads the research group "Combinatorial Optimization and Graph Algorithms" (COGA). He has held earlier positions as associate and assistant professor at the University of Bonn, the University of Hildesheim, and the RWTH Aachen. His research interests center around graph algorithms, combinatorial optimization, scheduling, logistics, and industrial applications. Part of his research has been done in DFG Research Center Matheon, where he was Scientist in Charge of Application Area "Logistics, traffic, and telecommunication networks". He has been chair of the German Operations Research Society and the Mathematical Programming Society and has been awarded the Scientific Award of the German Operations Research Society and the EURO Gold Medal of the European Association of Operational Research Societies. Since 2014 he is a honorary professor at the Beijing University of Technology and in the Board of the Beijing Institute for Scientific and Engineering Computing BISEC.

Don B. Zagier has spent most of his professional life in Germany, but is an American. After completing two undergraduate degrees in mathematics and physics in MIT in 1968, he did his doctoral work in Oxford and then Bonn, completing his doctorate in 1972 and obtaining his Habilitation three years later. After two postdoc years at the ETH in Zürich and the IHES in

Bures he returned to Bonn and has been there ever since, but always with another position in another country: from 1979 to 1990 as a Chair Professor at the University of Maryland, from 1990 to 2001 as a professor at the University of Utrecht, from 2001 to 2014 as a professor at the Collège de France in Paris, and since 2014 as an associate of the International Centre for Theoretical Physics in Trieste. In Bonn he worked for the "Sonderforschungsbereich Theoretische Mathematik" from 1971 until the founding of the Max Planck Institute for Mathematics in 1984 and as a scientific member and later director of the MPIM since then. He was also a titular professor of Kyushu University in Fukuoka during 1990–91 and 92–93, as well as having had a number of other long- or short-term visiting positions. He is a member of several academies and has been awarded various prizes. His main area of research is number theory, and in particular the theory of modular forms, but with many interconnections to other disciplines, in particular topology (including knot theory), algebraic K-theory, and mathematical physics (e.g. the applications of Jacobi forms, a theory that he co-invented with Martin Eichler, to string theory and the theory of black holes). He is the author or co-author of some 200 research publications, including 10 books, and has supervised 20 doctoral theses.

Appendix 2: Explanation of the SEP criteria and categories

The Standard Evaluation Protocol 2015-2021 asks review committees to assess three criteria:

Research quality

- Level of excellence in the international field
- Quality and Scientific relevance of research
- Contribution to body of scientific knowledge
- Academic reputation
- Scale of the unit's research results (scientific publications, instruments and infrastructure developed and other contributions).

Relevance to society

- Quality, scale and relevance of contributions targeting specific economic, social or cultural target groups;
- Advisory reports for policy;
- Contributions to public debates.
- The point is to assess contributions in areas that the research unit has itself designated as target areas.

Viability

- The strategy that the research unit intends to pursue in the years ahead and the extent to which it is capable of meeting its targets in research and society during this period;
- The governance and leadership skills of the research unit's management.

The meaning of the four categories in SEP 2015-2021 is as follows:

Category	Meaning	Research quality	Relevance to society	Viability
1	World leading/excellent	The unit has been shown to be one of the most influential research groups in the world in its particular field.	The unit makes an outstanding contribution to society	The unit is excellently equipped for the future
2	Very good	The unit conducts very good, internationally recognised research	The unit makes a very good contribution to society	The unit is very well equipped for the future
3	Good	The unit conducts good research	The unit makes a good contribution to society	The unit makes responsible strategic decisions and is therefore well equipped for the future
4	Unsatisfactory	The unit does not achieve satisfactory results in its field	The unit does not make a satisfactory contribution to society	The unit is not adequately equipped for the future

Appendix 3: Programme of the site visit

Sunday		15-nov-15	
17:00	20:00	Preparatory meeting	PRC, secretay
20:00	21:30	Dinner in hotel	PRC, secretay

Monday		16-nov-15	
8:30	9:15	General preparation	PRC, secretary
9:15	10:00	Preparing Vrije Universiteit Amsterdam (VU)	PRC, secretary
10:00	10:45	Preparing Amsterdam (UvA)	PRC, secretary
10:45	11:15	Interview management VU (dean/institute director)	Prof.dr. Karen Maex –Dean Prof.dr. Mathisca de Gunst - Chair Department of Mathematics
11:15	11:30	break	
11:30	12:00	Interview management UvA (dean/institute director)	Prof.dr. K.I.J. Maex – Dean Prof.dr. E.M. Opdam - Institute director Dr.ing. M. Kranenburg - Institute manager
12:00	12:45	Lunch	PRC, secretary
12:45	13:45	Interview programme leaders VU (content)	Prof.dr. Jan Bouwe van den Berg Prof.dr. Mathisca de Gunst Prof.dr. Rob de Jeu Prof.dr. Ger Koole Prof.dr. Ronald Meester Prof.dr. Rob van der Vorst
13:45	14:30	PhD students (VU)	Berry Bakker Ruben van der Geer Patrick Hafkenscheid Timber Kerkvliet Nurzhan Nurushev
14:30	14:45	break	
14:45	15:45	Interview programme leaders UvA (content)	Prof.dr. E.M. Opdam – AGMP Prof.dr. L.D.J. Taelman - AGMP Prof.dr. J.J.O.O. Wiegerinck - Analysis Prof.dr. R. P. Stevenson - Analysis Prof.dr. J.H. van Zanten - Stochastics Prof.dr. M.R.H. Mandjes - Stochastics
15:45	16:30	PhD students (UvA)	K.J.L. Wang B.L. Sevenster M. Goncalves de Martino D. Broersen J. Hartog N.J. Starreveld
16:30	17:15	Evaluation VU	PRC, secretary
17:15	18:00	Evaluation UvA	PRC, secretary
18:30	21:00	Dinner in Amersfoort	PRC, secretary

Tuesday		17-nov-15	
9:00	9:45	Preparing Utrecht (UU)	PRC, secretary
9:45	10:15	Interview management (dean/institute director)	Prof.dr. Gunther Cornelissen – Head MI Prof.dr. Gerrit van Meer – Dean Prof.dr. Sjoerd Verduyn Lunel – Scientific Director MI
10:15	11:15	Interview programme leaders (content)	Prof.dr. Frits Beukers - MI general Prof.dr. Marius Crainic - Fundamental Mathematics Prof.dr. Jason Frank - Mathematical Modelling
11:15	11:30	break	
11:30	12:15	PhD students (UU)	Felix Beckebanze Hüseyin Sen Kan Jiang Ori Yudilevich Valentijn Karemaker
12:15	13:00	lunch	PRC, secretary
13:00	13:45	Evaluation UU	PRC, secretary
13:45	14:30	Preparing Leiden (UL)	PRC, secretary
14:30	15:00	Interview management (dean/institute director)	Prof. Geert de Snoo Dean Prof. Peter Stevenhagen – scientific director MI until 15/9/2015 Prof. Aad van der Vaart – scientific directeur MI Dr. Bart de Smit – director of education MI
15:00	16:00	Interview programme leaders (content)	Analysis and Stochastics: Prof. Frank den Hollander Prof. Arjen Doelman Prof. Aad van der Vaart Algebra, Geometry, Number Theory: Prof. Peter Stevenhagen Dr. Bart de Smit
16:00	16:15	break	
16:15	17:00	PhD students (UL)	Björn de Rijk Andrea Roccaverde Mima Stanojkowski Djordjo Milovic
17:00	17:45	Evaluation UL	PRC, secretary
18:30	21:00	Dinner in hotel	

Wednesday		18-nov-15	
9:00	9:45	Preparing Nijmegen (RU)	PRC, secretary
9:45	10:15	Interview management (dean/institute director)	Prof. Dr. F. Vaandrager Prof. Dr. E. Koelink Prof. Dr. B. Moonen
10:15	11:15	Interview programme leaders (content)	Prof. Dr. N. Landsman Prof. dr. G. Heckman Prof. Dr. E. Cator Prof. Dr. B. Moonen
11:15	11:30	break	
11:30	12:15	PhD students (RU)	Johan Crommelin Bert Lindenhovius Norbert Mikolajewski Joshua Moerman Joost Nuiten
12:15	12:45	lunch	PRC, secretary
12:45	13:30	Preparing Groningen (RuG)	PRC, secretary
13:30	14:00	Interview management (dean/institute director)	prof.dr. K. Poelstra (Vice Dean FWN) prof.dr. Roerdink (director JBI) prof.dr. Wit (chair JBI Board)
14:00	15:00	Interview programme leaders (content)	prof.dr. G. Vegter prof.dr. A.J. van der Schaft prof.dr. R.W.C.P. Verstappen prof.dr. E.C. Wit
15:00	15:15	break	
15:15	16:00	PhD students (RuG)	M.H. Silvis H. Jardon Kojakhmetov M. Signorelli A.R.F. Everts
16:00	16:45	Evaluation RuG	PRC, secretary
16:45	17:00	break	
17:00	17:45	Evaluation RU	PRC, secretary
18:30	21:00	Dinner in Amersfoort	PRC, secretary

Thursday		19-nov-15	
9:00	9:45	Preparing Eindhoven (TU/e)	PRC, secretary
9:45	10:15	Interview management (dean/institute director)	prof.dr. Jakob de Vlieg (dean) prof.dr.ir. Barry Koren (vice-dean research) prof.dr. Johan van Leeuwaarden (director Graduate Program Mathematics) prof.dr. Wil Schilders (director Project Development Office)
10:15	11:15	Interview programme leaders (content)	dr.ir. Remco Duits (CASA) prof.dr. Mark Peletier (CASA) prof.dr.ir. Jan Draisma (DM) prof.dr. Tanja Lange (DM) prof.dr. Edwin van den Heuvel (STO) prof.dr. Remco van der Hofstad (STO)
11:15	11:30	break	
11:30	12:15	PhD students (TU/e)	
12:15	13:00	lunch	PRC, secretary
13:00	13:45	Evaluation TU/e	PRC, secretary
13:45	14:00	break	
14:00	14:45	PhD students (TUD)	Mohit Kumar Pieter van den Berg Richard Kraaij Menel Rahrah Nick Lindemulder
14:45	15:45	Interview programme leaders (content)	Arnold Heemink Geurt Jongbloed Jan van Neerven Dion Gijswijt
15:45	16:00	break	
16:00	16:30	Interview management	Rob Fastenau (dean EWI) Ben de Pagter (chair DIAM)
16:30	17:15	Evaluation TUD	
18:30	21:00	Dinner in hotel	

Friday		20-nov-15	
9:00	9:45	Preparing Twente (UT)	PRC, secretary
9:45	10:15	Interview management (dean/institute director)	Prof. dr. P.M.G. Apers – Dean prof. dr. ir. M.R. van Steen - Scientific director CTIT prof. dr. S.A. van Gils -replacing Head of Department
10:15	11:15	Interview programme leaders (content)	prof. dr. M.J. Uetz – Operations Research prof dr. R.J. Boucherie – Operations Research prof. dr. ir. B.J. Geurts – Scientific Computing prof dr. S.A. van Gils – Scientific Computing
11:15	11:30	break	
11:30	12:15	PhD students (UT)	Gijs Kooij Pim van der Hoorn Maartje van de Vrugt Koen Dijkstra Sjoerd Gevers
12:15	13:00	lunch	PRC, secretary
13:00	13:45	Evaluation UT	PRC, secretary
13:45	15:30	General evaluation (part I)	PRC, secretary
15:30	16:00	Presentation preliminary results by chair	all participants
16:00	17:30	General evaluation (part II)	PRC, secretary

Appendix 4: Quantitative data

According to SEP 2015-2021 quantitative data on the research unit's composition and financing are compulsory. However, the committee concluded that the quantitative data on financing are provided in a way that makes it impossible to use them in a similar way for all nine universities. Direct funding strongly depends on the amount of service teaching in mathematics. Since the amount of service teaching in mathematics varies strongly between universities, the quantitative information on financing provides no useful information on the amount of direct funding that is dedicated to research purposes. The committee therefore decided not to take direct funding into consideration, nor the percentages of second and third stream funding.