Mathematics

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Quality Assurance Netherlands Universities (QANU)
Leidseveer 35
P.O.Box 8035
3503 RA Utrecht
Netherlands
Phone : +31 (0) 30 236 3800
Telefax : +31 (0) 30 236 3805
E-mail : info@qanu.nl
Internet : www.qanu.nl

Quality assessment of education and research in Dutch universities was until recently carried out by the Quality Assurance department of the VSNU. In 2004 the activities of this department were transferred to QANU, which assumes responsibility for completion of the VSNU activities initiated before 2004.

Contents

Preface

This report summarizes the results of an evaluation of the research programs in mathematics in the Netherlands during the period 1996–2001. In accordance with the general *VSNU Protocol 1998* for the period 1998–2003 and the *Discipline Protocol Mathematics,* the evaluation was performed by a Review Committee consisting of a chair and six members with expertise in the relevant subdisciplines. The evaluation was based on a set of self-assessment reports prepared by the universities in 2002 in accordance with the guidelines of the general *Protocol* and the *Discipline Protocol*, additional material submitted to the Committee in the summer of 2003, and interviews that took place during a series of reverse site visits in Utrecht, the Netherlands, in August 2003. Although the formal mandate to the Committee was limited to an assessment covering the six-year period 1996–2001, additional material for the year 2002 was submitted by the universities and taken into consideration by the Committee.

The Committee thanks the universities for their efforts in preparing the documentation submitted for this evaluation. The self-assessment reports and supplementary material contained much information that proved to be essential for an objective evaluation of the various research programs.

Preliminary evaluations of each program were prepared independently by two members of the Committee in the spring of 2003. These evaluations defined the initial state for the evaluation process. At the reverse site visits, the Committee met with the directors of each of the research programs or their representatives, who were interviewed and given an opportunity to present their perspective on their programs. In addition, the Committee met with representatives of each of the faculties (usually the dean and the research director) and representatives of the various research schools. Opportunities were also provided for interaction with the chairs of the "Advies Commissie Wiskunde" (ACW), "Overleg Onderzoekscholen Wiskunde" (OOW), "Akademie Raad voor de Wiskunde" (ARW), and VSNU-Kamer voor Wiskunde and for informal discussions with representative groups of graduate students from the various universities. These interactions were most informative and certainly crucial for the evolution of the opinions within the Committee toward a final state.

The Committee appreciates the amount of time and effort spent by the many visitors on the reverse site visits and expresses its appreciation to the various representatives for their willingness to share their impressions (and concerns) with the Committee.

The Committee acknowledges the work of Harry Luttikholt and Bas Bauland of the VSNU, who not only assisted the Committee in all matters administrative but also made sure that Committee members were well catered to during their stay in Utrecht. Editorial assistance during the final stages of the drafting of the report was provided by Dr. Gail Pieper of Argonne National Laboratory.

As chair of the Committee, I thank my fellow Committee members for their commitment to the evaluation process and for their thoughtful contributions to this report. I deeply appreciate their willingness to take on this rather formidable challenge and am pleased that this report reflects the consensus opinions of the Committee.

Hans G. Kaper
Chairman

1 Introduction

1.1 The Dutch System for Quality Assessment of Research

The quality assessment of research in mathematics is part of the assessment system for all university research in the Netherlands performed under the aegis of the Association of Universities in the Netherlands (VSNU). This system was initiated in 1993 with trial assessments by four international committees of four diverse disciplines: biology, historical and archaeological studies, mechanical engineering, and psychology. The observations reported by these committees were subsequently used by the universities to enhance the assessment system, and the general principles and procedures were laid down in the *1993 Protocol* for the Quality Assessment of Research. From 1993 until 1997, all university research was assessed, by discipline or scientific area, by means of peer review (international committees of experts within the discipline) following this protocol. In 1997, when nearly all areas had been assessed, the system was evaluated by the VSNU Committee on the Future of Quality Assessment. On the basis of this Committee's advice, the VSNU Board decided to have the first round of VSNU research quality assessments followed by a second round. Again, the general principles and procedures, with a number of changes in comparison with the first round, were laid down in a protocol (*Protocol 1998)* for the period 1998–2003. The assessment of research in mathematics, which is described in this report, is one of the last assessments carried out in accordance with this protocol. For the period 2002–2009, the Association of Universities in the Netherlands (VSNU), the Netherlands Organization for Scientific Research (NWO), and the Royal Netherlands Academy of Arts and Sciences (KNAW) have jointly worked out a Standard Evaluation Protocol for Public Research Organizations.

The most important functions of the assessment system remain quality assurance (improvement of the quality of university research as a result of self-regulation within universities, faculties, or research schools), accountability, and the collection of information that is considered relevant to third parties.

The goals of the assessment system are threefold:
- To assess the quality of research programs (groups) on the basis of self-evaluations and an appraisal of how the work is related to the group's mission as well as to the mission of the faculty or the institute of which the group's program is a part
- To evaluate the mission of faculties or institutes, as well as the group's own mission
- To appraise the state of the art in the discipline or academic area concerned

The assessment takes place at the aggregate level of research programs. Highly valued features of the assessment are the interviews, which the review committee conducts during a series of site visits (or reverse site visits) with delegations of the faculty boards, the directors of the research institutes or research schools, and the program directors. The interviews with the delegation of the faculty boards focus especially on a discussion of the faculty's research profile based on the faculty's research poli**cy.**

1.2 The Review Committee for Mathematics

The Review Committee for Mathematics was appointed on 4 April 2003 and consisted of the following:
- Prof. Dr. Hans G. Kaper, National Science Foundation, Washington, DC, Chairman
- Prof. Dr. Heinz Langer, Institute of Analysis and Technical Mathematics, Vienna University of Technology, Austria
- Prof. Dr. Rolf Jeltsch, Seminar for Applied Mathematics, ETH Zürich, Switzerland
- Prof. Dr. Alf J. van der Poorten, Centre for Number Theory Research, Macquarie University, Australia
- Prof. Dr. Norbert A'Campo, Mathematical Institute, University of Basel, Switzerland

- Prof. Dr. Gyula O. H. Katona, Renyi Institute, Budapest, Hungary
- Prof. Dr. Geoffrey Grimmett, Department of Pure Mathematics and Mathematical Statistics, Cambridge University, United Kingdom

Drs. Harry W. Luttikholt, VSNU, was appointed Secretary of the Review Committee.

A short curriculum vitae of each committee member is included in Appendix 1.

1.3 Scope of the Assessment

The Committee was asked to operate according to the *Protocol 1998*. For the assessment of mathematics, this protocol was elaborated in the Discipline *Protocol Mathematics*, prepared by the deans of faculty concerned. The assessment covers the entire field of mathematics, including the following:
- Analysis
- Applied analysis
- Algebra
- Geometry
- Discrete mathematics
- Statistics and probability

The Committee assessed 45 research programs from the following universities:
- Leiden University (LEI), Mathematical Institute (3 programs)
- Utrecht University (UU), Mathematical Institute (4 programs)
- University of Groningen (RUG), Institute of Mathematics and Computing Science (6 programs)
- Erasmus University Rotterdam (EUR), Rotterdam School of Economics (1 program)
- University of Amsterdam (UvA), Korteweg-de Vries Institute for Mathematics (3 programs)
- Free University, Amsterdam (VU), Department of Mathematics (3 programs)
- Nijmegen University (KUN), Department of Mathematics (4 programs)
- Delft University of Technology (TUD), Applied Mathematics Research Program (8 programs)
- Eindhoven University of Technology (TUE), Division of Mathematics (8 programs)
- Twente University, Enschede (UT), Faculty of Mathematical Sciences (3 programs)
- Wageningen University (WU), Discipline of Mathematics (1 program)
- Maastricht University (UM), Department of Mathematics (1 program)

The assessment covered the period 1996–2001. Additional information was provided for the year 2002. The Committee did not sollicit external reviewers.

1.4 Data Provided to the Committee

The Committee received the following documentation:
- Self-assessment reports of the participating faculties and universities, following the format prescribed in the *Protocol 1998* and the *Discipline Protocol*
- Additional information provided by the participating faculties and universities in response to four questions submitted by the Committee in June 2003 (see Appendix 2)

The self-assessment reports summarize the results that have been achieved in each research program during the period under review, including quantitative data about staff input and research output, five key publications, a list of all publications, a short mission statement for each program, and a description of developments anticipated in the context of the research profile of the faculty or institute. The mission statement should contain elements such as the scope of the research, the nature of the research in terms of pure versus applied, the general

approach of the research in terms of unidisciplinary, multidisciplinary or interdisciplinary, and the principal sources of inspiration (curiosity-driven or society-driven). It should also say something about goals and objectives, indicate the local identity (for example, its place in a research school), and describe the relevance of the work to the different audiences.

The Committee noted a considerable variation not only in the quality but also in the quantity of the information provided in the self-assessment reports. Some universities chose to ignore the guidelines given in the protocols and submitted, for example, progress reports that far exceeded the suggested number of pages, or more than five key publications per program. Such deviations violate the principle of a fair and unbiased evaluation. The Committee recommends that, in future evaluations, any submission that does not meet the stated conditions be returned without review.

1.5 Procedures Followed by the Committee

The agreements set forth in the *Discipline Protocol* determined the extent of the review, which was limited to the research programs of the participants mentioned in Section 1.3. These participants submitted a total of 45 programs (see Appendix 3).

The Committee began the review process by summarizing the key data provided by the participating institutions (see Section 2.3). First and second reviewers were selected for each research program, and each reviewer was asked to review the information provided for the program and assess the program using a preliminary assessment form (see Appendix 4). The assessment forms were collected as input for a thorough discussion at the first meeting of the full Committee on 25 August 2003. During this meeting, a consensus was reached on a first approximation of the numerical scores (ratings, or "grades") and on the topics that would be discussed with the representatives of the various programs during the reverse site visits. The reverse site visits took place in Utrecht during the period 25–29 August 2003. The Committee interviewed the deans of faculty and the program directors or their representatives of the 45 research programs. The Committee finalized the numerical scores on 29 August, before adjourning. The Committee members submitted draft comments for each of the 45 programs during the ensuing months, and a final draft of the Committee report was sent to the Committee members in March 2004. As stipulated in the protocol, this final draft was also submitted to the faculties concerned for their final comments. The Committee's chairman and secretary then finalized the report, which was presented to the Board of VSNU in the spring of 2004.

1.6 Aspects of Assessment

The *VSNU Protocol* requires an assessment of the following aspects for each research program:

(a) **Academic quality** of the output of the research group: What is the quality of the results produced? What position has been achieved in a national and international context?
(b) **Academic productivity** of the research group: How productive has the research group been, given the input in terms of human resources?
(c) **Relevance** of the research program: How significant has the research been for the development of the discipline? For academic disciplines with a strong strategic or applied element, relevance also refers to the societal or technological impact: How significant has the research been for the development of societal or technological applications?
(d) **Viability** of the research program: What is the long-term viability of the selected problem areas and of the research program's approach? What are the prospects for the research program, bearing in mind national and international competition?

In addition, the Review Committee is asked to assess the faculty's research profile and to give a critical review from an international perspective of the situation in the discipline or academic

area as a whole and in each faculty or institute concerned. In this part of the assessment, the specific context of the work carried out in the research group, faculty, or institute should be taken into account.

Academic Quality

The *VSNU Protocol* states that the assessment of the academic quality is based on the quality of the output in the research group: dissertations, academic publications, and, where relevant, professional publications, patents, and other academic products such as tests, prototypes, and software. Aspects of the assessment include the academic level of the publications, with respect to the publication media in which they appear, the originality and coherence of the research, and the contribution to the development of the discipline or area. Due regard is given to the international standing of (the members of) a research group in assessing the quality of its achievements. Notice is taken of participation in international cooperative projects, membership of editorial boards of international journals, academic awards, invitations to attend international conferences, visiting appointments, research funding acquired from organizations like the Netherlands Organization for Scientific Research (NWO), and so forth.

Within the overall framework of the *VSNU Protocol*, the Committee based the assessment of academic quality on the following aspects, as specified in the preliminary assessment form (Appendix 4):

- Originality of approaches and ideas in tackling scientific problems
- Coherence and cumulative character of the research
- Contributions to international scientific developments
- Quality of the academic publications and of the journals in which they appeared
- Indicators of international recognition other than publications, such as positions in international scientific networks and advisory appointments based on academic reputation

Academic Productivity

The *VSNU Protocol* states that the academic productivity is assessed by relating the output in terms of the number of publications (in total and in each category) to the input in terms of human resources. In order to do justice to those groups with missions supplementary to strictly "curiosity-driven" research, due attention should also be given to other forms of academic output. In the comments accompanying each assessment, the Review Committee therefore should compare the academic quality and productivity with the objectives or mission of the research program as submitted by the research group. The research group's policy regarding publications should also be taken into account. For this reason, it is not always feasible to assess productivity in the form of a numerical score; in some cases, narrative comments may be more appropriate.

The Committee based the assessment of academic productivity on the following aspects:

- Publications in national and international refereed journals and scientific books demonstrating the contributions of the staff members to academic knowledge and understanding
- The number of Ph.D. theses, in relation to tenured staff
- Presentations at international conferences and publications in the proceedings of such meetings
- Other scientific output such as professional publications and patents

Relevance

The *VSNU Protocol* states that assessment of the output cannot be considered independently of its relevance: What significance does the research have for the development of the discipline? Are the issues and the approaches chosen with insight, given the international state of scholarship in the discipline concerned?
In academic fields with a strong component of strategic or applied research, the issue of academic relevance is inseparable from that of societal and technological impact. As in the case of productivity, here too the context should be taken into account, and the relevance should

be specified in the description of the group's mission. The minimum requirements for these missions will be a basic academic framework: Is the work of a kind that can be expected from an academic group? Furthermore, a mission could include contributions to the frontiers of science, support for other academic areas, or support for applied sciences. There is a growing interest in assessing the societal impact of research, too. Here again, the stated mission of the group should be taken into account. In the comments accompanying each assessment, the Committee's views of the relevance of the research should be compared with the research group's own viewpoint as expressed in its mission statement. In view of the many different aspects of this criterion, it will not always be feasible to express the assessment in a numerical score; a narrative comment may be more appropriate, according to the Protocol.

In accordance with these guidelines, the Committee based the assessment of relevance on the following aspects:
- The advancement of knowledge or expertise
- The significance of the contribution of a research group to the development of its field with special focus on originality of ideas and approaches
- The contribution of the research group to relevant scientific and professional networks of (future) users (government, agencies, industry, and others) based on its specific knowledge and expertise
- The balance between fundamental and applied research
- Success in obtaining funding from secondary and tertiary sources

Viability

The VSNU Protocol states that the assessment must take into account the direction in which the research program is developing. The Committee should, as far as possible, comment on the viability of the issues and the research approach chosen in the international academic arena. In some areas, competitive strength will soon depend largely on factors of scale and the available academic infrastructure. The cohesion of the program should also be a part of the assessment of academic viability.

In accordance with these guidelines, the Committee based the assessment of viability on the following aspects:
- Whether it is worthwhile to continue the research topics, on the basis of the group's ideas and plans for the future (academic prospects)
- Prospects of future funding of personnel and facilities
- Continuity of leadership for the program
- Coherence of the program.

The group's mission statement and plans are judged against the feasibility of developing or sustaining the research. Guarantees for continuity of leadership at a high academic level are seen as a major aspect of the viability of a program.

Ratings

The VSNU Protocol requires the Review Committee to carry out the following tasks:
- Assess each of the four aspects (quality, productivity, relevance, and viability) of each program separately on a five-point scale
- Comment on each of the four aspects (quality, productivity, relevance, and viability) of each program separately as appropriate (these comments form an integral part of the assessment)

The numerical scores (ratings, or "grades") are given on a five-point scale (1–5). According to the VSNU-Protocol, they have the following significance:

Excellent	(5)
Good	(4)
Satisfactory/average	(3)
Unsatisfactory	(2)
Poor	(1)

Excellent (5): The research group belongs to the international elite within its field of research. It works at the frontiers of international progress in its field and contributes effectively to that progress by means of substantial publications in highly rated scientific journals.

Good (4): The group meets the international standards in its field of research, and it makes worthwhile and recognized contributions to the international research community.

Satisfactory (3): The group meets the international standards in its field of research at an acceptable level, and its contributions to knowledge are of satisfactory quality.

Unsatisfactory (2): The group does not meet the international standards in its field; it needs some improvement to contribute significantly.

Poor (1): The group is far from meeting international standards in its field and has no influence on the field's development. A reorientation is needed before the group can be expected to contribute.

The Review Committee complied fully with the *VSNU Protocol* for its assessment of the research programs in mathematics.

2 Summary

2.1 General Perspective

The mathematical sciences identify and study structures, patterns, and the structural harmony of patterns; they create concepts that unify and clarify relationships among seemingly disjoint phenomena in the physical, biological, and social world.

The mathematical sciences are disciplines in themselves, with their own vitality and need for nourishment. But they also serve as the fundamental tool and language for science, engineering, industry, management, and finance. They are inextricably linked to these "user" fields and frequently draw their inspiration from them. Thus mathematics[1] has a dual nature: it is both an independent discipline valued for precision and intrinsic beauty and a rich source of tools for the world of applications. One might say that mathematics has abstractness internally and effectiveness externally.

The mathematical sciences research community differs from other research communities in several ways. Mathematical research is the epitome of "small" science; that is, much research is done by individuals working alone or in small teams. Also, the results of mathematical research are long lasting; once proven, a theorem remains true. The current mathematical literature is rich in references to the older literature, so mathematicians are more dependent than other scientists on access to a good library. The publication rate among mathematicians is lower than that for other scientists, and papers are generally longer, because the emphasis is as much on the manner in which the results were obtained as on the results themselves. Moreover, most research mathematicians are university based, so their culture has an academic orientation.

The mathematical sciences—like all other sciences—are pursued in a world that is changing rapidly. Both the techniques of the sciences and the needs of society are dramatically more complex than those of the past. They require new mathematical ideas and methods as well as increased openness by mathematicians to problems of other disciplines and more effective collaboration between mathematicians and scientists in the other disciplines.

The number of active researchers in the mathematical sciences worldwide is small – the International Mathematical Union lists approximately 50,000 active mathematicians in 2002 – so that any given research area may be populated by only a few highly specialized individuals. They know each other, have developed a common language, and collaborate internationally and frequently.

The impact of mathematics on society is pervasive, and there is ample historical evidence that every area of mathematics, however abstract, has important applications. Maintaining and enhancing the historical strength of the mathematical sciences as an intellectual endeavour and as a foundation for applications are a prerequisite for sustaining a knowledge-based economy.

2.2 The Netherlands Perspective

The Netherlands enjoys a high standard of living, not by chance but because of prudent management of resources and strategic investments, by both government and industry, in science and technology. An extensive system of higher education has contributed to the creation of a skilled workforce that is able to sustain a knowledge-based economy.

The mathematical sciences are an integral part of the educational system. Research and teaching go hand in hand; separating the two would significantly affect the vitality of the discipline.

[1] Throughout this report, "mathematics" should be interpreted as "the mathematical sciences" and "the sciences" as "science, engineering, technology, medicine, business, and other applications."

2.3 Key Findings

> 2.3.1 General Remarks

The Committee found that the quality of mathematical research in the Netherlands is high but not consistently high. The best work, especially on the more fundamental side, measures up to the best work internationally and is recognized by frequent citations. This finding is consistent with a long tradition of academic research and historical strengths in the more fundamental areas of mathematics. The quality is not uniform, however, a situation that is reflected in the individual ratings of the various programs. The Committee is not certain that the research programs on the more applied side have a firm grasp of their mission. Although some programs are reaching out to new areas of applications, the scope is still limited, and important new areas of application are missing. Moreover, frequent and repeated reorganizations have taken their toll on the stability of some research programs.

The mathematics research enterprise in the Netherlands is healthy. The challenges are to maintain its strength on the more fundamental side, to more clearly identify its mission in outreach activities, and to increase its visibility.

> 2.3.2 Research Input

Based on the self-assessment reports, the Committee estimates that in 2001 the country spent approximately 43 million Euros for mathematics research in the 12 universities under review. This investment translated into approximately 360 FTEs dedicated exclusively to research. The comparable figure for the entire six-year period under review, 1996-2001, is 2,055 FTEs. These data are summarized in Table 1.

The figure of 2,055 FTEs represents an annualized increase of 18% over the same figure presented to the Committee reviewing research in mathematics and computer science during the five-year period 1991–1995, when approximately 1,500 FTEs were dedicated to research in the mathematical sciences alone.[2] Much of the increase was the result of increased funding from external sources (NWO, STW, and others) and has benefited primarily junior researchers in temporary positions. At the same time, the Committee noted a decrease in the number of senior academic staff affecting the continuity of some research programs.

> 2.3.3 Research Output

The Committee counted a total of 352 Ph.D. dissertations during this same period. In other words, each year the mathematics research community produced approximately 60 individuals who received an advanced degree that required them to show some proficiency in thinking abstractly and using the tools of mathematics. *This is a respectable number, but is it enough to sustain a healthy research enterprise, educate a technically trained workforce, and satisfy the needs of Dutch society as a whole?*

The standard mechanism for disseminating the results of academic research in the mathematical sciences is either through publications in peer-reviewed journals or through presentations at conferences and workshops. The latter case, becoming more common in mathematics, may result in a contribution to conference proceedings; the degree to which such papers are subject to peer review varies considerably. The Committee agreed that counting papers or published pages per capita is distasteful but not entirely unreliable for a self-defined group of researchers and taken over a six-year period.

[2] "Quality Assessment of Research. Mathematics and Computer Science at the Dutch Universities," VSNU, September 1997.

According to the self-assessment reports, the total number of articles authored or coauthored by mathematicians in the Netherlands and published in peer-reviewed journals during the period 1996–2001 is close to 3,450. If one includes articles that appeared in conference proceedings, the total figure comes close to 5,300. These are significant numbers, although the Committee is not in a position to compare them with international standards in mathematics or national standards in other disciplines.

A satisfactory standard could be an average of two "publication events" per year for permanent academic staff (full, associate, and assistant professor) and at least one such event per year for temporary staff (fellows, postdocs, and Ph.D. students). Since these figures could not be extracted from the self-assessment reports, the Committee adopted two numbers as guidelines to measure productivity: (1) the ratio of the number of Ph.D.s divided by the number of FTEs of academic staff, and (2) the ratio of the number of publications divided by the total number of FTEs (permanent plus temporary). The data are summarized in Table 2. A rating of Satisfactory would thus correspond to productivity near the median rate, with a variation if merited by either measure.

> 2.3.4 Quality of the Research

More important than their number is the quality of the publications. Here the Committee based its evaluation on the key publications supplied with the self-assessment reports and on the reputation of the journals in which the remaining publications had appeared. The Committee's judgment is reflected in the ratings given for quality of the various programs.

We emphasize that care is needed in making comparisons between the current assessments and those in the 1997 report (cited in footnote 2). The current Committee had different evaluators, and it is not always easy to detect the changes that may have occurred in the intervening years in one program or another. The present judgment is like another snapshot taken with a different camera.

On the whole, the Committee judges the quality of the research in mathematics in the Netherlands to be good. The best work, especially on the more fundamental side, is on a par with the best research done internationally.

> 2.3.5 Relevance of the Research

Judging the relevance of each research program was sometimes problematic. For the more fundamental areas of mathematics the Committee could do little more than decide whether the work was relevant to the advancement of mathematics generally. That left relevance close to quality: only good mathematics is relevant for the advancement of the field. For mathematics reaching out into other areas of science, the Committee also considered whether that outreach was indeed likely to be effective and appropriate.

In general, the Committee judges the level of relevance manifested by the various research programs to be satisfactory.

> 2.3.6 Viability of the Research Programs

Some research groups can have little future, say because of retirements (forced or otherwise) or university or department policy. Few if any areas of mathematical research, however, become nonviable in and of themselves.

Unless the Committee was advised to the contrary, it assumed at least satisfactory viability.

2.4 Observations

> 2.4.1 Student Numbers

A persistent problem in the Netherlands is the small number of incoming students who choose to major in the sciences. The problem is not unique to the Netherlands, but it appears to be particularly serious there. According to the self-assessment reports, approximately 1,400 students were enrolled in the mathematical sciences in 2001. Since this figure includes students at VU and UM who are majoring in informatics, the true number is probably closer to 1,300. This number is cause for serious concern and needs to be addressed at the national level. *The health of the discipline, and thus the economic health of the country, is at stake.*

The Committee realizes that some efforts to increase student enrollment have been made. The issue has also been highlighted in several excellent reports.[3]

The Committee feels strongly that it is time to take action at the national level and to make a career in the mathematical sciences a more attractive option for high-school graduates.

During the interviews the current state of affairs was almost always attributed to the lack of quality of high-school teaching, exacerbated by teachers often having no university experience. Other factors operate as well; however, those additional factors are less likely to be influenced by mathematicians' efforts. The Committee discussed this issue at some length, although strictly speaking it was not part of its mandate. As active research mathematicians, we know that the frontiers of science and mathematics are advancing at a very rapid pace and that it is exciting to be a part of the mathematics research enterprise. It is important that this same sense of excitement is transmitted to the students at the earliest opportunity, and certainly at the high-school level. But because the education community appears to be effectively disconnected from the academic research community in the Netherlands, this sense of excitement goes largely unnoticed where it is most needed.

The Committee suggests that the mathematics community urge decision makers to give future science and mathematics teachers first-hand research experience by integrating their education in the academic curriculum.

Becoming a teacher of mathematics and science in secondary schools must remain a realistic option for all students at all times during their academic studies. The Committee has a number of suggestions:

- Create the option for Ph.D.s to choose a teaching career as an alternative to an academic or industrial research career. The current preparation for a Ph.D. degree by an AIO already contains a fair amount of experience in teaching.
- Give bachelors in mathematics the right to teach in secondary schools, possibly after some additional training in didactics and school experience under qualified mentors.
- Give academic graduates who decide to choose a teaching career in secondary education a discount on their debts for each year they teach.
- Create opportunities for teachers (and other bachelor graduates) to progress to a master's qualification and beyond on a part-time basis.

Mathematics is considered a difficult subject, and starting a study in mathematics carries a considerable financial risk. In a market-driven economy, it is not unusual to create economic incentives to mitigate the risk and stimulate collective behavior to achieve a desired objective.

The Committee recommends that serious thought be given to the idea that students who choose mathematics as their field of study be exempt from paying tuition.

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[3] "De toekomst van het wiskunde-onderzoek in Nederland" (KNAW, 1999); "Nieuwe dimensies, ruimer bereik" (OOW, 2002); "Masteropleidingen Wiskunde in Nederland" (2003).

> 2.4.1 Women in the Workforce

The Committee asked each program to provide a list of female faculty with their rank in 1996 and in 2001 (see Appendix 2, Question 4). The results are summarized in Table 3.

The Committee notes that only marginal progress has been made in hiring and promoting women in the mathematics research community during the reporting period.

The Committee realizes that the issue is difficult. But the issue does not go away by itself; a change of attitude and more affirmative action are needed. The country cannot afford to ignore one-half of the population.[4]

> 2.4.2 Structural Issues

Several Committee members noted the extent to which in many of the universities the existence of a research field depends on the existence of a chair expounding that research interest. In fact, the Committee observed that those departments that defined their research programs independently of the interests of the full professors and their circle of adherents are likely to have an advantage in comparison with international standards.

In the Netherlands, only a full professor (hoogleraar) has the Ius Promovendi. On the other hand, the Committee observed that other permanent academic staff (UHD, UD) are often the de facto advisors of Ph.D. students. It commends this practice because it makes the number of Ph.D. students less sensitive to the comings and goings of the full professors. On the other hand, although the UHD or UD has done most of the advising, the expertise of the UHD or UD is only marginally recognized.

The Committee noted a certain rigidity and lack of transparency in the promotion procedures in various departments. Too often, the system is "frozen in place." It is not clear whether this situation is a consequence of the pyramidal structure built around "chairs," but it does prevent easy adjustment to new opportunities and lead to frustrations and, in the worst case, loss of talent.

The Committee recommends flexibility and openness in hiring and promotion procedures. The best talent needs to be attracted and rewarded appropriately.

> 2.4.3 Research Schools

Much research in the mathematical sciences is carried out under the aegis of research schools: Stieltjes Institute, Mathematics Research Institute (MRI), and Euler Institute for Discrete Mathematics and its Applications (EIDMA). In addition, many research programs are affiliated with research schools focusing on other disciplines. These research schools were organized to mitigate the fact that many departments had become subcritical. The schools provide research and training opportunities to Ph.D. students and, in general, coordinate research functions in the Netherlands. The Committee interviewed staff as well as students of the Stieltjes Institute and the MRI and received generally positive feedback. The attitudes toward the research schools varied, though, from a desire to leave them as they are, to a suggestion to merge the Stieltjes Institute and the MRI, to the opinion that the research schools had had their time and were no longer needed. The Committee refrains from giving a judgment.

[4] The Committee took note of its own homogeneity. It regrets the fact that no serious effort was made by its governing authorities to bring diversity to its composition.

> 2.4.4 Infrastructure

Several of the reports alluded to the disappearing of departmental libraries, journal cancellations, and the like. Researchers might feel better were they to acknowledge that useful mathematical information is in fact more readily accessible than it ever was. Digital libraries are becoming increasingly comprehensive. If one does not mind reading the literature on a screen or printing an article on a departmental laser printer, one has access to more literature than a traditional library can ever provide. As a corollary, the computational infrastructure is becoming correspondingly critical, not only for reference purposes but also for research. Here, the Committee received generally positive responses; most universities seem well equipped to meet the current needs of the mathematicians.

Table 1: Key Data

	Income (kEuro)				Expenses (kEuro)			HR (FTE)		Students	Research
	1	2	3	Total	Personnel	Other	Total	Academic	Support	Math/Stat	Input (FTE)
TUE	5,739	340	1,092	7,171	6,139	540	6,679	94.9	17.5	155	63,6
TUD	6,477	602	408	7,487	5,705	1,704	7,409	96.1	15.6	182	55.8
UT	7,026	614	934	8,574	6,467	1,849	8,316	87.6	17.9	178	48.6
UU	4,135	442	15	4,592	3,924	1,059	4,983	62.6	10.2	194	45.0
UvA	1,437	455	216	2,108	1,867	238	2,105	38.4	2.5	94	34.9
LEI	1,829	527	41	2,397	2,316	260	2,576	36.0	4.6	70	27.4
VU	2,819	136	91	3,046	2,659	364	3,023	35.0	9.0	220	24.1
RUG	2,205	181	34	2,420	2,024	299	2,323	35.0	3.6	112	23.3
KUN	2,397	75	20	2,492	2,152	244	2,396	29.6	4.2	60	18.9
EUR	609	41	0	650	650	28	678	10.5	0.5	0	7.2
WU	1,402	0	73	1,475	1,395	82	1,477	21.2	1.5	0	6.5
UM	573	24	91	688	636	34	670	9.3	2.9	149	5.6
Total	**36,648**	**3,437**	**3,015**	**43,100**	**35,934**	**6,701**	**42,635**	**291.5**	**70.8**	**1,414**	**360.9**

Notes: Departments ordered by Research Input (last column)
"VU Students" includes students majoring in Bedrijfskunde en Informatica"
"UM Students" includes students majoring in "Informatica"

Table 2: Productivity Data

	Input (FTE)						Output					
	2001			1996-2001			1996-2001					
	Acad	Temp	Total	Acad	Temp	Total	PhDs	Articles	Pubs	PhD/Acad FTE	Art/FTE	Pub/FTE
LEI												
LEI 01	2.7	10.5	13.2	13.0	45.8	58.8	13	88	114	1.00	1.50	1.94
LEI 02	1.9	7.1	9.0	13.1	56.0	69.1	7	118	139	0.53	1.71	2.01
LEI 03	2.6	2.6	5.2	13.5	17.1	30.6	5	56	75	0.37	1.83	2.45
Subtotal	**7.2**	**20.2**	**27.4**	**39.6**	**118.9**	**158.5**	**25**	**262**	**328**	**0.63**	**1.65**	**2.07**
UU												
UU 01	4.1	9.7	13.8	24.4	89.6	114.0	16	130	204	0.66	1.14	1.79
UU 02	5.3	16.3	21.6	31.3	88.9	120.2	16	149	242	0.51	1.24	2.01
UU 03	0.8	2.0	2.8	4.6	3.2	7.8	2	10	26	0.43	1.28	3.33
UU 04	2.1	4.7	6.8	12.9	31.9	44.8	8	94	111	0.62	2.10	2.48
Subtotal	**12.3**	**32.7**	**45.0**	**73.2**	**213.6**	**286.8**	**42**	**383**	**583**	**0.57**	**1.34**	**2.03**
RUG												
RUG 01	0.8	3.8	4.6	4.8	22.8	27.6	4	19	32	0.83	0.69	1.16
RUG 02	1.2	1.9	3.1	7.9	8.7	16.6	2	48	79	0.25	2.89	4.76
RUG 03	0.5	2.7	3.2	4.6	24.8	29.4	8	27	43	1.74	0.92	1.46
RUG 04	1.1	3.1	4.2	7.0	17.0	24.0	7	52	130	1.00	2.17	5.42
RUG 05	0.4	2.4	2.8	6.3	19.2	25.5	3	37	58	0.48	1.45	2.27
RUG 06	1.1	4.4	5.5	10.1	19.0	29.1	8	26	66	0.79	0.89	2.27
Subtotal	**5.1**	**18.3**	**23.4**	**40.7**	**111.5**	**152.2**	**32**	**209**	**408**	**0.79**	**1.37**	**2.68**
UvA												
UvA 01	2.1	14.3	16.4	14.2	69.2	83.4	10	154	159	0.70	1.85	1.91
UvA 02	3.2	6.8	10.0	17.5	30.6	48.1	15	181	184	0.86	3.76	3.83
UvA 03	3.1	6.0	9.1	14.5	24.4	38.9	12	82	83	0.83	2.11	2.13
Subtotal	**8.4**	**27.1**	**35.5**	**46.2**	**124.2**	**170.4**	**37**	**417**	**426**	**0.80**	**2.45**	**2.50**

	Input (FTE)						Output					
	2001						1996--2001					
	Acad	Temp	Total	Acad	Temp	Total	PhDs	Articles	Pubs	PhD/Acad FTE	Art/FTE	Pub/FTE
EUR												
EUR 01	3.6	4.0	7.6	22.9	20.0	42.9	5	101	109	0.22	2.35	2.54
Subtotal	**3.6**	**4.0**	**7.6**	**22.9**	**20.0**	**42.9**	**5**	**101**	**109**	**0.22**	**2.35**	**2.54**
VU												
VU 01	2.1	7.1	9.2	13.9	28.7	42.6	4	81	110	0.29	1.90	2.58
VU 02	1.5	4.3	5.8	8.1	20.7	28.8	3	77	86	0.37	2.67	2.99
VU 03	2.9	4.9	7.8	13.1	25.9	39.0	5	93	118	0.38	2.38	3.03
VU 04	0.8	0.5	1.3	4.8	0.5	5.3	0	4	19	0.00	0.75	3.58
Subtotal	**7.3**	**16.8**	**24.1**	**39.9**	**75.8**	**110.4**	**12**	**255**	**333**	**0.30**	**2.31**	**3.02**
KUN												
KUN 01	1.7	3.8	5.5	9.5	25.3	34.8	4	35	44	0.42	1.01	1.26
KUN 02	1.0	1.8	2.8	6.4	8.3	14.7	2	17	21	0.31	1.16	1.43
KUN 03	1.9	4.3	6.2	13.3	33.7	47.0	6	95	144	0.45	2.02	3.06
KUN 04	1.4	2.8	4.2	10.1	21.8	31.9	6	64	71	0.59	2.01	2.23
Subtotal	**6.0**	**12.7**	**18.7**	**39.3**	**89.1**	**128.4**	**18**	**211**	**280**	**0.46**	**1.64**	**2.18**
TUD												
TUD 01	3.2	4.6	7.8	19.9	21.8	41.7	5	144	176	0.25	3.45	4.22
TUD 02	3.6	1.4	5.0	20.4	21.8	42.2	4	59	81	0.20	1.40	1.92
TUD 03	1.4	2.9	4.3	9.6	25.4	35.0	11	59	105	1.15	1.69	3.00
TUD 04	1.6	10.7	12.3	10.2	40.3	50.5	16	57	127	1.57	1.13	2.51
TUD 05	2.4	6.3	8.7	15.7	65.9	81.6	14	67	218	0.89	0.82	2.67
TUD 06	3.3	5.1	8.4	17.5	20.8	38.3	5	73	105	0.29	1.91	2.74
TUD 07	0.9	1.1	2.0	5.0	16.6	21.6	4	36	100	0.80	1.67	4.63
TUD 08	1.4	5.9	7.3	7.9	32.0	39.9	6	104	163	0.76	2.61	4.09
Subtotal	**17.8**	**38.0**	**55.8**	**106.2**	**244.6**	**350.8**	**65**	**599**	**1,075**	**0.61**	**1.71**	**3.06**

	Input (FTE)						Output					
	2001						1996-2001					
	Acad	Temp	Total	Acad	Temp	Total	PhDs	Articles	Pubs	PhD/Acad FTE	Art/FTE	Pub/FTE
TUE												
TUE 01	3.3	9.4	12.7	16.4	23.0	39.4	5	83	116	0.31	2.11	2.95
TUE 02	2.7	12.7	15.4	15.1	64.6	79.7	9	66	112	0.60	0.83	1.41
TUE 03	1.3	2.3	3.6	9.1	9.4	18.4	2	31	91	0.22	1.68	4.95
TUE 04	1.6	0.0	1.6	11.2	10.4	21.5	4	57	75	0.36	2.65	3.48
TUE 05	1.7	6.9	8.6	10.2	34.3	44.5	8	79	121	0.79	1.77	2.72
TUE 06	2.1	3.1	5.2	9.3	28.6	37.9	8	48	68	0.86	1.27	1.80
TUE 07	2.3	6.6	8.9	11.3	28.5	39.8	9	38	81	0.80	0.95	2.03
TUE 08	2.2	5.4	7.6	13.2	37.7	50.9	6	82	112	0.45	1.61	2.20
Subtotal	**17.2**	**46.4**	**63.6**	**95.7**	**236.4**	**332.1**	**51**	**484**	**776**	**0.53**	**1.46**	**2.34**
UT												
UT 01	5.8	10.0	15.8	29.3	43.5	72.8	12	151	211	0.41	2.07	2.90
UT 02	5.6	13.2	18.8	31.6	87.1	118.7	17	119	229	0.54	1.00	1.93
UT 03	2.5	10.0	12.5	16.7	45.9	62.6	6	83	260	0.36	1.33	4.15
Subtotal	**13.9**	**33.2**	**47.1**	**77.6**	**176.5**	**254.1**	**35**	**353**	**700**	**0.45**	**1.39**	**2.75**
WU												
WU 01	2.8	3.7	6.5	16.2	20.4	36.6	22	124	195	1.36	3.39	5.33
Subtotal	**2.8**	**3.7**	**6.5**	**16.2**	**20.4**	**36.6**	**22**	**124**	**195**	**1.36**	**3.39**	**5.33**
UM												
UM 01	2.6	3.0	5.6	15.4	16.5	31.9	8	51	86	0.52	1.60	2.70
Subtotal	**2.6**	**3.0**	**5.6**	**15.4**	**16.5**	**31.9**	**8**	**51**	**86**	**0.52**	**1.60**	**2.70**
Total			**360.3**			**2055.1**	**352**	**3,449**	**5,299**			
Median										**0.53**	**1.69**	**2.56**

Definitions Acad: Full, Associate, Assistant Professor (hgl, uhd, ud)
Temp: Fellow, Postdoc, Grad Student (aio)
Article: Refereed journal publication
Publication: Journal article, (Contribution to) book, Proceeding paper, Other
Median: Taken over all programs

Table 3: Female Faculty Members in 1996 and in 2001

VSNU 2003 - Women in the Academic Staff								
	1996				2001			
	UD	UHD	HL	Total	UD	UHD	HL	Total
LEI	1	0	0	1	1	0	1	2
UU	1	0	0	1	1	0	0	1
RUG	0	0	1	1	0	0	1	1
UvA	0	0	0	0	0	0	0	0
EUR	0	0	0	0	0	0	0	0
VU	0	0	0	0	1	0	0	1
KUN	0	0	0	0	1/2	0	0	1/2
TUD	1	0	0	1	2	0	0	2
TUE	0	0	0	0	2	0	0	2
UT	2	0	0	2	4	0	0	4
WU	4	0	0	4	5	0	0	5
UM	0	0	0	0	0	0	0	0
Total	**9**	**0**	**1**	**10**	**16 1/2**	**0**	**2**	**18 1/2**

3 Assessment per Faculty or Institute and per Program

3.1 Leiden University, Mathematical Institute

The Mathematical Institute of Leiden University (Universiteit Leiden, LEI) is a research institute within the Faculty of Science of the university. Its policy is to maintain a balance between pure and applied mathematics. Research ranging from fundamental and abstract to applied and concrete is supported in three clusters of disciplines: Algebra, Number Theory and Geometry; Analysis; and Stochastics.

In the Committee's judgment, the research programs at LEI strike a fair balance between core mathematics and outreach mathematics. The department is a strong and active partner in the research community in the Netherlands. Its financial and human resources are comparable to those of UvA and RUG. The Committee commends LEI for its vision in supporting a viable mathematics research program despite the department's disappointingly low number of students.

The department is well aware of the necessity to increase its undergraduate enrolment and is taking direct action, for example by visiting regional high schools. The festivities centred on the number pi in the Pieterskerk in 2000 were another noteworthy attempt to increase the awareness of mathematics among the general public. The Committee also noted that the department has initiated a joint venture with TUD, following similar successful pilot ventures in other basic sciences, whereby first-year undergraduates receive credit for courses taken at either institution. This initiative should result in increased educational opportunities for the students. It may also alleviate the present financial difficulties at TUD. These efforts, born of necessity, are to be encouraged. The Committee believes, however, that the persistently low student numbers are an urgent national problem that must be addressed at the highest levels; see the general observations in Section 2.4.1.

Mathematics research at LEI is a healthy enterprise. The quality is good to excellent; some programs do outstanding work. The productivity is satisfactory, as measured by both the number of Ph.D.s produced and the number of publications. The refocusing of the analysis program will provide more coherence and will bring the program in line with current developments at other major institutions. The establishment of a bioscience initiative at the level of the Faculty offers an excellent opportunity to reach out to new areas of applications, including computation.

The mathematicians at LEI participate in several research schools and are active in supporting the Lorentz Center. The Lorentz Center offers an outstanding facility for bringing graduate students and postdoctoral researchers to the frontiers of research in the physical and biological sciences.

The Committee strongly supports the plans to introduce a tenure-track system for junior researchers. A flexible policy of promoting talent, combined with a transparent system of quality control, will enhance the career prospects of the best and the brightest and improve the motivation of the department faculty.

The Committee assessed the following research programs:

LEI 01:	Algebra, Number Theory and Geometry
LEI 02:	Analysis
LEI 03:	Stochastics

LEI 01

University	LEI	
Program	Algebra, Number Theory and Geometry	
Program director	Prof.dr. P. Stevenhagen	
FTE 2001	2.7	
Assessment	Quality	5
	Productivity	3
	Relevance	5
	Viability	5

Program description/key words:
Algebraic Number Field, Class Field, Complex Multiplication, Computational Number Theory, Diophantine Approximation, Diophantine Equation, Transcendence, Code, Finite Field, Complex Differential Geometry, Complex Manifold, Contact Geometry, Kobayashi-Hitchin Correspondence

The program tries to bridge the gap between abstract theory and the world of algorithms and applications. It might be viewed as number theory in the broadest sense, ranging from discrete dynamical systems to arithmetic geometry and motives, with a strong emphasis on algebraic methods and a direct interest in the computational aspects of the theory.

Committee's comments:

This is an outstanding program with excellent work in a variety of areas of algebra, algebraic geometry, arithmetic geometry, number theory, and their applications. Its participants are conscious of actions that need to be taken, and indeed are being taken, to maintain and add to the program's strengths. The group acknowledges that, notwithstanding strong results in the reporting period, it can and should increase its Ph.D. output—subject, of course, to students of suitable quality being found, perhaps by active search from international sources. Appointments late in and since the reporting period have further strengthened the group and broadened its expertise. The university deserves credit for allowing the department, notwithstanding its low student intake, to grow and renew itself so that it can readily withstand eventual retirements.

LEI 02

University	LEI	
Program	Analysis	
Program director	Prof.dr. S. M. Verduyn Lunel	
FTE 2001	1.9	
Assessment	Quality	5
	Productivity	3
	Relevance	5
	Viability	4

Program description/key words:
Berezin Forms, Maximal Degenerate Representations, Multibump Solutions,Pattern Formation, Initial Value Problem, Numerical Stability, Feedback Systems with Time Delay, Large-Time Behavior of Systems, Nonlinear Maps, Reaction-Diffusion Equations

The Institute's leadership intends to define a more coherent program in Analysis under a one-headed management. The program will focus on functional analysis, nonlinear analysis, dynamical systems, and applications in the sciences, in particular physics, chemistry, and biology.

Committee's comments:

During the assessment period, the group continued research of excellent quality in the four subprograms (Analysis on Lie Groups; Analysis and Applied Mathematics; Numerical Analysis; and Analysis, Dynamical Systems and Applications). However, because of the retirement of three prominent group leaders, the number of chairs will be reduced from four to one by 2004, and three of the subprograms will be terminated. The Committee fears that, with only one chair remaining, the high international reputation of mathematical research in analysis at LEI can hardly be sustained. If the focus will be on "computational analysis" as declared, at least a strong component (chair) in Numerical Analysis seems to be needed.

LEI 03

University	LEI	
Program	Stochastics	
Program director	Prof.dr. S. A. van de Geer	
FTE 2001	2.6	
Assessment	Quality	4
	Productivity	3
	Relevance	5
	Viability	4

Program description/key words:
Classification, Contact Process, Curve Estimation, Discrete-Event Control, Model Selection, Nonparametric Statistical Models, Penalized Estimation, Ergodicity, Fluid Limit, Markov Decision Chain, Optimal Control, Queuing Network, Stochastic Game

The stochastics program at LEI is inspired by and oriented toward applications, but the nature of the research is mainly fundamental.

Committee's comments:

The program includes two subgroups, one in Statistics and one in Operational Research. The quality of the research is good, and some of it is very good, especially under the new leadership in Statistics. The trend for quality and Ph.D. output is rising, the latter having been low. Taking into account service training and the financial health of the group, the arguments for expansion in Statistics are strong, and consistent with the establishment of the bioscience initiative at the level of the Faculty. The future of Operational Research is less certain, given the growing cooperation with TUD in the organization of teaching programs.

3.2 Utrecht University, Mathematical Institute

The Mathematical Institute of Utrecht University (Universiteit Utrecht, UU) is part of the Faculty of Mathematics and Computer Science of the University. The common mission of its research programs is to advance the insight in mathematical structures from different perspectives. The programs derive their inspiration from structures and phenomena in science and scientific computation or from the realm of abstract mathematics itself.

The Committee appreciates the broad vision of mathematics at UU. The Institute supports research that advances insight in mathematical structures from different perspectives. Consistent with this vision, it maintains a wide spectrum of activities, both in the core areas of the discipline and at the interface of the discipline with other disciplines, without succumbing to the tendency to compartmentalize. The department submitted four programs for review: Algebra, Geometry and Mathematical Logic; Analysis; History of Mathematics; and Stochastics and Decision Theory, where each program represented a more or less continuous spectrum of diverse research activities. This strategy allows for maximal flexibility, encourages innovation, and leaves room for more traditional endeavours. The Mathematics in Focus program is a good example of innovative thinking that enhances the visibility of mathematics as a living enterprise. The department has an enlightened personnel policy, encourages sabbatical leaves, and maintains a high profile both nationally and internationally.

The key data provided in the self-assessment report indicate that UU occupies a middle position between the larger technical universities and the mostly smaller, nontechnical universities (UvA, LEI, RUG) in financial and human resources as well as in the number of students and the number of FTEs available for research. The income derived from contract research (third-money stream) is smaller than at any other university, consistent with the department's focus on the more fundamental aspects of the discipline.

The Committee judges the quality of the research to be excellent. Several members of the department have an outstanding international reputation. The department is able to maintain and nurture specialist subgroups, as illustrated, for example, by the activities in the history of mathematics. The overall productivity of Ph.D.s as well as the number of research publications is satisfactory. Ongoing work is highly relevant, and the viability of the department is beyond doubt. The university can be proud of its Mathematics Institute.

The Committee assessed the following research programs:

UU 01:	Algebra, Geometry and Mathematical Logic
UU 02:	Analysis
UU 03:	History of Mathematics
UU 04:	Stochastics and Decision Theory

UU 01

University	UU	
Program	Algebra, Geometry and Mathematical Logic	
Program director	Prof.dr. E.J.N. Looijenga	
FTE 20001	4.12	
Assessment	Quality	5
	Productivity	3
	Relevance	5
	Viability	5

Program description/key words:
Arithmetic Algebraic Geometry, Number Theory, Singularity Theory, Moduli Spaces, Algebraic Groups, Commutative Algebra, Algorithms and Computer Algebra, Algebraic Topology

The group views the subjects within the program as a continuous spectrum, ranging from topological methods in logic, to geometry, algebra, and algebraic geometry, to arithmetic geometry and arithmetic. In a number of cases, the work done within the program is motivated by developments in other parts of mathematics or science and vice versa.

Committee's comments:

This large and varied group stands out by virtue of the broad scope of its research and its successful endeavor to promote flexibility and contact both between fields of mathematics and between abstraction and application. The research produced is outstanding in its quality and generality and ranges over a wide variety of cutting-edge parts of algebraic and complex geometry, algebra, and number-theoretical applications and in work at the interfaces between mathematics and physics.

UU 02

University	UU	
Program	Analysis	
Program directors	Prof.dr. J.J. Duistermaat, H.A. Van der Vorst (Numerical Analysis) and prof.dr. O. Diekmann (Applied Analysis)	
FTE 2001	5.31	
Assessment	Quality	5
	Productivity	3
	Relevance	5
	Viability	5

Program description/key words:
Applied Analysis, Numerical Analysis, Pure Analysis

The three subprograms (Applied Analysis, Numerical Analysis, and Pure Analysis), although well defined, have obvious overlaps. Dynamical systems and partial differential equations appear prominently in the program. Algebra is a major tool in Numerical Analysis. Stochastic methods appear in the Applied Analysis program.

Committee's comments:

The Analysis program of UU is the largest such program in the Netherlands in terms of the number of senior faculty and the number of junior staff. The program is coordinated by four full professors, each of high international reputation. The three subprograms are coherent, ranging from dynamical systems in the applied sciences to PDEs and Lie groups and scientific computing, and there seems to be a good interplay among them. The members of the Analysis program participate actively in national and international collaborations. The number of Ph.D.s per senior FTE is close to the statistical national average; however, the number of publications per FTE is below the statistical average.

UU 03

University	UU	
Program	History of Mathematics	
Program director	Prof.dr. H.J.M. Bos	
FTE 2001	0.76	
Assessment	Quality	4
	Productivity	3
	Relevance	4
	Viability	4

Program description/key words:
Early Modern Mathematics, Descartes, Exactness, Construction, Analysis, Algebra, Medieval Islamic Mathematics and Astronomy, Greek Mathematics, Mathematics Education, Mosaics, Set Theory, L.E.J. Brouwer, History of Intuitionism

The group sees its mission as producing and promoting solid research in the history of mathematics, with results formulated in clear and concise prose, published in scholarly monographs and in articles in refereed specialist journals of high international standing.

Committee's comments:

A comparison of this research group with the others is difficult. However, knowing the history and the development of mathematics is undoubtedly important, and the work of this small group has a high international reputation. The output in terms of the number of publications is excellent. The output in terms of the number of Ph.D.s is low, but the Committee understands the difficulties in attracting students to this area of research. The Committee finds it promising that the group now consists of two senior members and two PhD students, in addition to a temporary NWO-paid researcher.

UU 04

University	UU	
Program	Stochastics and Decision Theory	
Program director	Prof.dr. R.D. Gill	
FTE 2001	2.15	
Assessment	Quality	5
	Productivity	3
	Relevance	4
	Viability	5

Program description/key words:
Semiparametric Models, Curve Estimation, Percolation Theory, Probabilistic Polymer Models, Optimization Theory, Quantum Statistics

The mission of the program is to initiate, and contribute to, significantly developing core areas in these fields, emphasizing connections between the fields, connections to the main body of mathematics, with a view to applications in science and technology.

Committee's comments:

This dynamic and well-led group is broad in its interests, covering aspects of probability, statistics, game theory, and quantum information. The group has done much good work on an international scale, some of which has been very good. Strong appointments have been made, and the group has benefited from the presence in the Netherlands of EURANDOM. Productivity has been satisfactory. The Committee encourages the staff to make a concerted effort to increase the number of Ph.D. students and postdoctoral fellows.

3.3 University of Groningen, Institute of Mathematics and Computing Science

The Institute of Mathematics and Computing Science of the University of Groningen (Rijksuniversiteit Groningen, RUG) is a research institute within the Faculty of Mathematics and Natural Sciences of the university. Its main goal is to perform research at a high international level leading to publications in international scientific journals and a steady stream of highly qualified researchers (at the Ph.D. level).

The Committee rates the quality of the mathematics research programs at RUG from satisfactory to excellent.

During the assessment period, mathematics at RUG experienced some drastic changes because of the retirements of several senior researchers. In the group of universities that are comparable in terms of total budget and number of academic FTEs for mathematics research (LEI, RUG, UvA), RUG now has the smallest mathematics research program. The research portfolio, with an input of approximately 40 academic (staff) FTEs over the six-year period, is spread over six programs. While the research input per program in 1996 still averaged 1.3 academic FTEs, this number has now dropped to less than 0.9 FTEs—certainly too small to make for a viable and balanced research program.
A university of the standing of RUG needs a mathematics department of reasonable size, not only for its mathematics research programs, but also for the education of a scientifically literate workforce in other disciplines where mathematics finds its applications.

At the interview with the Committee, the dean indicated a commitment to significantly increase the permanent staff of the institute. The Committee welcomes this commitment and expresses the hope that the new appointments will enable the institute to realize its plans for a vital mathematics program.

The Committee assessed the following research programs:

RUG 01: Algebra and Geometry
RUG 02: Analysis
RUG 03: Dynamical Systems
RUG 04: Systems and Control
RUG 05: Probability and Statistics
RUG 06: Computational Mechanics and Numerical Mathematics

RUG 01

University	RUG	
Program	Algebra and Geometry	
Program director	Prof.dr. M. van der Put	
FTE 2001	0.8	
Assessment	Quality	5
	Productivity	3
	Relevance	5
	Viability	3

Program description/key words:
Algebraic Geometry, Rigid Analytic Spaces, Differential Equations, Arithmetic of Elliptic Curves, Galois Representations

Most of the research is in pure mathematics, and the themes reflect personal interests and international tendencies in mathematical research. The range of the research is rather wide and multidisciplinary. The inspiration comes from interaction with the international mathematical community, but some of the themes are inspired by applications.

Committee's comments:

This fine research group produces outstanding work in differential Galois theory and algebraic/arithmetic geometry. However, the group essentially comprises only two individuals and will be reduced further by retirement in the relatively near future. Surely, if only for teaching reasons, but perhaps also for reasons of a long and distinguished history in the areas of geometry, algebra, and number theory, RUG will wish to retain a concentration in the general area. Indeed, the Committee's "grade" for viability is based on the assumption that the university will act promptly to strengthen the group for the long term rather than wait to recreate the group after it has faded away.

RUG 02

University	RUG	
Program	Analysis	
Program director	Prof.dr. E.G.F. Thomas	
FTE 2001	1.2	
Assessment	Quality	4
	Productivity	3
	Relevance	4
	Viability	Not Applicable

Program description/key words:
Ordinary Differential and Difference Equations, Stokes Phenomenon, (Generalized) Nevanlinna Functions, Reproducing Kernel Spaces, Extension and Perturbation of Operators, Integral Representations, Choquet Theory, Path Integrals

At the beginning of the assessment period, the group consisted of four professors working on three themes (complex analytic ordinary differential and difference equations, operator theory and applications, and a theory of path distributions). During the assessment period, one of the professors retired; at the end of the period, a second one left to join another group within the department; and a third one will retire in 2004. The group will thus be left with only one full professor.

Committee's comments:

The quality of the work is good and internationally acknowledged; parts of it may be characterized as "niche research." The productivity as measured by published research papers has increased considerably since the last assessment report: the number of publications per FTE is now among the highest in the Netherlands. Most publications have appeared in internationally leading journals. However, the number of Ph.D. students is far too low.

The Committee believes that a university of the caliber of Groningen must have a strong group in analysis, not only for the mathematics programs, but also to support the research and education programs in other disciplines. Therefore, the department should give high priority to the development of an extended new program in analysis.

RUG 03

University	RUG	
Program	Dynamical Systems	
Program director	Prof.dr. H. W. Broer	
FTE 2001	0.5	
Assessment	Quality	4
	Productivity	3
	Relevance	5
	Viability	3

Program description/key words:
Quasi-Periodic Dynamics, Chaotic Dynamics, Bifurcations, Resonance, Simulation and Visiualization, Time Series

The main aim of the program is to understand qualitative aspects of the dynamics of deterministic systems with finitely many degrees of freedom.

Committee's comments:

The former head of the group, who was one of the leaders in the field, retired after two-thirds of the assessment period. With only one full professor, who is also involved in administration, and one staff member working here only 45% of the time, the group had fallen below the critical size by the end of the assessment period. Nevertheless, good and sometimes excellent work has been done. The number of Ph.D.s produced by the group is exceptionally high; on the other hand, the number of papers per FTE is below average. The Committee notes that, after the end of the reporting period, the long-term viability of the group improved with the addition of a professor from the RUG Analysis program.

RUG 04

University	RUG	
Program	Systems and Control	
Program director	Prof.dr.ir. J.C. Willems; since 1 January 2003 prof.dr. R.F. Curtain	
FTE 2001	1.1	
Assessment	Quality	5
	Productivity	5
	Relevance	4
	Viability	3

Program description/key words:
Systems, Control, Linear Systems, Infinite-Dimensional Systems, Behaviors, Identification, Robust Control, LQ-Control, H-Infinity Control

The research program encompasses problems in modeling, analysis, and synthesis of open dynamical systems, with applications to control and signal processing. The aim is to pose and answer fundamental questions involving the development of basic concepts and mathematical techniques including algorithms.

Committee's comments:

Research in the Systems and Control program has been of exceptional quality. The productivity has been excellent, both in the number of publications and the number of Ph.D. s produced. Concerning the viability, the Committee notes that after the reporting period some steps were taken to initiate a generation change; however, stronger actions are needed.

RUG 05

University	RUG	
Program	Probability and Statistics	
Program director	Prof.dr. W. Schaafsma	
FTE 2001	0.4	
Assessment	Quality	4
	Productivity	3
	Relevance	4
	Viability	Not Applicable

Program description/key words:
Applied Probability, Time Series, Limit Theorems, Neural Networks, Distributional Inference, Applications

The research is directed to developing probabilistic models and statistical methods of inference and decision. The group aims to support the scientific community as a whole, within or beyond the academic community.

Committee's comments:

The high points of this program are the excellent work on extremal events and the publication of a major textbook. However, all members of the group have now left the university, and a new appointment in Statistics and Probability is anticipated. The future of a new group in this important area will hinge on the success of this appointment, and an assiduous pursuit of the target is strongly recommended.

RUG 06

University	RUG	
Program	Comp. Mechanics and Numerical Mathematics	
Program director	Prof.dr. A.E.P. Veldman	
FTE 2001	1.1	
Assessment	Quality	3
	Productivity	3
	Relevance	5
	Viability	3

Program description/key words:
Computational Fluid Dynamics, Hydro- and Aerodynamics, Turbulence and Transition, Bifurcation Analysis and Stability, Biofluid Mechanics, Numerical Algorithms, Iterative Methods, Higher-Order Discretization

With the continuing progress in numerical mathematics and computer technology, the impact of computer simulation on science and society is increasing rapidly. The research program forms an active part of this dynamic scene. The group specializes in the development of numerical solution methods for partial differential equations in general and for flow simulation in particular.

Committee's comments:

This program is focused on computational fluid dynamics (CFD) and has a strong orientation toward applications. The emphasis is on the development of numerical methods for PDEs, in particular those of fluid dynamics, and their implementation in large-scale computer codes. The effort does not seem to be supported much by analysis. A computer code (ComFlo) has been under development since 1995; the code is generally available and has been applied successfully to several problems of hydraulic and hydrodynamic engineering. As a result, the group is well positioned to collaborate with researchers in national laboratories and industry and thus to bring in external funding. The number of Ph.D.s produced by the group during the reporting period is low by international standards. The group's publication rate is about average.

Future research plans are poorly developed. Research will continue to emphasize CFD and turbulent flows, and ComFlo will be further developed. Applications outside the aerospace and maritime world are mentioned, but no details are given. The loss of the sole UHD and one of the two UDs at the end of 1999 is a matter of serious concern.

3.4 Erasmus University Rotterdam, Rotterdam School of Economics

Mathematics research at Erasmus University Rotterdam (EUR) is concentrated in the School of Economics. The mission of the School of Economics and, by implication, its mathematics program is to realize high-quality theory-driven research as well as policy-oriented research.

The Committee assessed the following research program:

EUR 01: Mathematics

			EUR 01
University	EUR		
Program	Mathematics		
Program director	Dr. R. J. Stroeker		
FTE 2001	3.2		
Assessment	Quality	3	
	Productivity	3	
	Relevance	3	
	Viability	3	

Program description/key words:

Operator Theory, Bifurcation, Matrix Analysis, Stochastic Processes, Computational and Algebraic Number Theory, Topology, Graph Theory, Optimal Decision Models, Location Theory, Duality, Optimization, Optimal Control

The program unifies a large part of the mathematically oriented research carried out by members of the Faculty of Economics. It should therefore be seen as an attempt to unify the activities of individual researchers working in rather distinct branches of mathematics. The research is carried out in five subprograms: (1) Functional Analysis, Operator Theory and Matrix Analysis; (2) Mathematical Analysis and Probability Theory; (3) Algebra and Geometry; (4) Discrete Mathematics; and (5) Mathematical Techniques with Relevance to Economic Theory.

Committee's comments:

The primary task of the mathematicians at EUR is to teach service courses for students at the Rotterdam School of Economics. Plans to organize a Faculty of Mathematics, which existed at the beginning of the seventies, were never realized. As a result, research at EUR is secondary, mostly left to the tastes of the individual staff members, and lacking coherence.

The quality of the research produced by the group during the reporting period was satisfactory; the production of Ph.D.s was, however, low.

The Committee urges the university to develop a clear policy for the future direction of the group. The self-assessment report listed five subprograms, at least two of which (subprograms 2 and 5) could be pursued advantageously in conjunction with the research programs in economics. The Committee recommends that the mathematicians at EUR seriously explore new avenues to enhance interactions with researchers in other disciplines of interest to the university. Here, the Stieltjes Institute could be a useful resource.

3.5 University of Amsterdam, Korteweg–de Vries Institute for Mathematics

The Korteweg–de Vries (KdV) Institute for Mathematics is the research institute for mathematics of the University of Amsterdam (Universiteit van Amsterdam, UvA). It is one of eleven research institutes in the Faculty of Science at UvA. These institutes are mostly independent and self-governing, and their primary mission is to do research. Key research themes in the KdV Institute are algebra and geometry, which are tightly coupled to mathematical physics, and applied and numerical analysis. The proximity of the KdV Institute and the Centrum voor Wiskunde and Informatica (CWI) has led to a close integration of the research activities at the two institutions. The members of the KdV Institute also take part in a variety of interdisciplinary activities, at the national as well as international level.

According to the key data provided in the self-assessment report, the financial resources of the KdV Institute are at the lower end compared to those of the other older (non-technical) universities (LEI, UU, RUG, VU). On the other hand, its human resources are slightly above those of LEI, RUG, and VU. This somewhat surprising observation may be the result of higher income from tertiary sources. The fact that UvA ranks well above the same institutions for research input may well be an interesting consequence of the same phenomenon. Research at UvA is closely integrated with research at the CWI. The Committee commends the leadership of the KdV Institute for its efforts to include the CWI in its activities through research partnerships and joint appointments. At the same time, the Committee notes that this close integration tends to blur the picture. A clean assessment of the UvA has been extremely difficult, if not impossible, and some of the Committee's judgments may have been skewed by this difficulty.

The quality of the research at the KdV Institute ranges, in the view of the Committee, from satisfactory to excellent. The program in mathematical physics is extremely strong and well regarded at the international level. The analysis group has undergone rejuvenation and appears to be poised to move in new directions. The productivity is satisfactory, as measured by the number of Ph.D.s produced and the number of publications.

A Scientific Advisory Board of three European (non-Dutch) mathematicians visits the KdV Institute once a year to assess research programs and outcomes. The Board could be a useful resource for the Institute in developing a strategy to stay relevant in the current international research environment. The Committee strongly supports the institute's efforts to evaluate staff members, especially junior staff members, on an annual basis.

The Committee assessed the following research programs:

UvA 01: Algebra, Geometry and Mathematical Physics
UvA 02: Pure, Applied and Numerical Analysis
UvA 03: Stochastics

UvA 01

University	UvA	
Program	Algebra, Geometry and Math. Physics	
Program director	Prof.dr. G. B. M. van der Geer	
FTE 2001	2.1	
Assessment	Quality	5
	Productivity	3
	Relevance	5
	Viability	5

Program description/key words:
Algebraic Groups, Algebraic Geometry, Finite Group Theory, Quantization and Noncommunicative Geometry, String Theory, Discrete Mathematics

This group's work centers on the lively areas of mathematics where geometry and algebra strongly interact. A large part of the dynamics of this area come from developments in mathematical physics, especially string theory and quantum field theory, which have supplied new ideas for mathematical developments.

Committee's comments:

The power and influence of this outstanding group's research in mathematical physics are evident through national and international recognitions. There is a strong presence in algebraic geometry and, in the reporting period, fine work in number theory under the rubric of arithmetic geometry. Overall, the quality of the group's work is top-rate by any standard.

UvA 02

University	UvA	
Program	Pure, Applied and Numerical Analysis	
Program director	Prof.dr. A. Doelman	
FTE 2001	3.2	
Assessment	Quality	4
	Productivity	3
	Relevance	4
	Viability	4

Program description/key words:
Dynamical Systems, Bifurcation Theory, Singular Pertubation Theory, Pattern Formation, Advection-Diffusion-Reaction Equations, Convection-Diffusion Problems, Pluripotential Theory, Orthogonal Rational Functions, Quantum Groups and Q-Special Functions

Within the wide area of applied, numerical and pure analysis, the program concentrates on three subprograms: Dynamical Systems; Numerical Analysis of PDEs; and Complex Analysis, Approximation Theory and Q-Analysis.

Committee's comments:

The analysis group is substantial, with two full-time and three part-time full professors in 2001. The programs of the subgroups appear coherent, and the quality of the work being done is good to excellent. The group is well connected internationally; one subprogram participates in an EU research network on Nonlinear Partial Differential Equations. The group in numerical analysis is to a large extent based in the CWI; the large number of Ph.D.s produced by this group may therefore not be entirely attributable to UvA (see the remarks in the general introduction to the Committee's assessment of the UvA). The publication rate in all three groups is good.

UvA 03

University	UvA	
Program	Stochastics	
Program director	Prof.dr. C. A. J. Klaassen	
FTE 2001	3.1	
Assessment	Quality	3
	Productivity	3
	Relevance	4
	Viability	4

Program description/key words:
Stochastic Processes, Diffusions, Queuing Theory, Semiparametrics, Nonparametrics, Quality Improvement, Statistical Process Control

Stochastics is an extremely broad field within mathematics, with ramifications in almost all sciences. The research in the program ranges over the whole spectrum of this field, with a focus on industrial statistics and financial mathematics at the applied side and on probability theory and mathematical statistics at the more theoretical side.

Committee's comments:

The area of concentration in Stochastics has continued to be semiparametrics, complemented with activity in nonparametric statistics. A special feature is the work on industrial statistics and the in-house consultancy unit IBIS. Increased activity has been reported in probability, based largely on the one-day/week employment of a high-profile researcher based at the CWI. The Committee is uncertain to what degree this has enhanced the research environment in probability at the university. Further development, preferably full time, in probability would be appropriate. The Committee noted the increasing trend in Ph.D. numbers and encourages the program to make every effort to maintain this positive development.

3.6 Free University Amsterdam, Department of Mathematics

The Department of Mathematics at the Free University Amsterdam (VU) is part of the Faculty of Science. The department's research policy aims to strike a balance between applications and the formal-logical nature of mathematics.

The department has undergone significant changes during the past decade. The number of full professors decreased from 13 to 7, because of retirements and budgetary restrictions. New appointments at both the junior and the senior level have resulted in a significant rejuvenation and a reorientation of the department's research programs. The average age in the group of full professors is now approximately 46, and the group as a whole has a healthy age structure. The Committee is confident that the department will experience a reasonable degree of stability in the coming years.

The department's research portfolio consists of three programs: Analysis, Geometry, and Stochastics; in addition, there are smaller programs in Consultancy and the History and Philosophy of Mathematics. The Analysis program has a new leader, who has brought in a strong team working on nonlinear PDEs; the work in operator theory, which has a strong tradition in the group, is being continued. In the Stochastics program, all three full professors were appointed during the assessment period.

Good to excellent work was done in each program during the assessment period. The programs and mission statements for the future look very coherent, with a good balance of fundamental research and research motivated by applications in the sciences, finance, business, and other fields. The three major research programs participate in European TMR or RTN networks, two of them as contractors. All research programs participate actively in national research schools, most significantly in the Thomas Stieltjes Institute, and they are closely linked with CWI and EURANDOM.

Among comparable universities, the production of research papers at VU is at the highest level, the output of Ph.D.s at the lowest level. The Committee notes that the rejuvenation of the faculty and a further focusing on multidisciplinary research are likely to put the department in a better position to improve its output of Ph.D.s.

The Department of Mathematics of the VU shares with the other universities the general problem of low student numbers. Still, the number of students per academic staff FTE (approximately 6) is more than twice the number at the other comparable universities, perhaps also as a consequence of the changes in the department. The Committee commends the department for its move to cooperate with the Korteweg–de Vries Institute of the University of Amsterdam (UvA) in the master's level education program.

The Committee's overall impression is that the Department of Mathematics at the VU has managed to overcome some of the problems of the past. The Committee is confident about the future of the department.

The Committee assessed the following research programs:

VU 01: Analysis
VU 02: Geometry
VU 03: Stochastics

VU 01

University	VU	
Program	Analysis	
Program director	Prof.dr. J. Hulshof	
FTE 2001	2.1	
Assessment	Quality	4
	Productivity	3
	Relevance	5
	Viability	4

Program description/key words:
Nonlinear Partial Differential Equations, Functional Differential Equations, Dynamical Systems, Free Boundary Problems, Integrable Systems, Numerical Analysis, Topological Variational Methods, Matrix and Operator Theory, System and Control Theory

The aim of the program is to develop methods for solving integral, differential, and matrix equations and to solve problems arising in applications, in particular in control and system theory. There is a strong interaction between both components, and a strict subdivision is neither wanted nor possible.

Committee's comments:

At the beginning of the assessment period (1996), the program consisted of two active subprograms: Operator Theory, and Integrable Systems (both functioning under the same chair), and a slumbering subprogram: Numerical Analysis. The former was highly visible, very productive, and under prominent leadership. Around 2000, the leadership changed as a result of retirements, and the focus of the group has since been redirected to applied analysis. The program now covers partial differential equations, operator theory and applications, and control and systems theory. The first two themes are also embedded in research training networks of the EU. With the appointments of the new faculty members, the generation change is almost complete, and the program is poised to become an active player again in the research community. The Numerical Analysis subprogam has been effectively dormant during the reporting period; however, the Committee was assured that steps would be taken to remedy the situation.

The production of Ph.D.s has been rather low, probably because of the turnover of the senior staff, but has been increasing recently. Given the new composition of the faculty, the Committee expects the program to become a more productive partner in the near future.

VU 02

University	VU	
Program	Geometry	
Program director	Prof.dr. J. van Mill	
FTE 2001	1.5	
Assessment	Quality	4
	Productivity	3
	Relevance	5
	Viability	3

Program description/key words:
Real Algebraic Geometry, Geometric Topology, Infinite-Dimensional Topology, Discrete Mathematics, Convexity

The main research lines are topology and real algebraic geometry. The former covers a broad area of research with geometric as well as functional-analytic aspects; the latter concentrates increasingly on pure mathematics.

Committee's comments:

This research group has an interesting range of emphases running slightly skew to those elsewhere in the Netherlands and therefore enriching the generality of national activity in geometry and algebra. During the reporting period the group conducted strong research in real algebraic geometry, geometric topology, and infinite-dimensional topology and useful contributions in discrete mathematics. Recent changes in personnel may significantly change the direction of the group in the near future, which may improve the productivity and viability of its research program.

VU 03

University	VU	
Program	Stochastics	
Program director	Prof.dr. A. W. van der Vaart	
FTE 2001	2.9	
Assessment	Quality	5
	Productivity	3
	Relevance	5
	Viability	5

Program description/key words:
Semiparametric Models, Empirical Processes, Diffusion Processes, Spatial Random Processes, Percolation, Long-Range Stochastic Dynamics, Interacting Particle Systems, Spread of Epidemics, Ergodic Theory, Stochastic Models in Biology, Statistical Inverse Problems, Asymptotic Statistics, Likelihood, Markov Decision Chains, Queuing Systems, Performance Analysis, Quantitative Logistics, Stochastic Operation Research, High-Dimensional Models

The program is directed at a range of topics in probability theory, statistics and operations research and their applications to other sciences and business. The mission of the program is to combine fundamental research in the mathematical theory of these topics, with multidisciplinary research motivated by applications of stochastics in other sciences, business, and industry.

Committee's comments:

Achievements of note in Stochastics include substantial theoretical advances and strong developing links with important areas of application in probability and statistics, with some very good work in each subtopic. Productivity has been good, and recent figures show an improvement in the previously low count of Ph.D.s.

3.7 Nijmegen University, Department of Mathematics

The Department of Mathematics at the University of Nijmegen (Katholieke Universiteit Nijmegen, KUN) is part of the Faculty of Science of the university. The department is small; the number of FTEs currently available for research is lower than at any other university in the Netherlands (except for those where mathematics plays primarily a service role). In the Committee's judgment, the number is, in fact, too low; the department cannot realistically claim that it is a full-fledged partner in the Dutch research community. Since the submission of the self-assessment report, the department and the university have adopted several measures that may allow for the continuing viability of a mathematics at KUN. The university has restructured the department by encouraging early retirements and by declaring certain positions to be "supernumerary" (thus not within the department's budget), clearing the way for developments including the creation of some new positions. The Committee has been informed that appointments to these new positions are imminent. At this point, it is too early to be confident that these actions and the department's specific strategy in emphasizing computational algebra, mathematical physics, and financial mathematics (see below) will be successful. However, the Committee is pleased that positive action is being taken to enhance the viability of mathematics research at KUN.

The Committee suggests that the department prepare a mission statement (missing from the current self-assessment report) that reflects a common vision for the future of the department, and that the University assist the department by developing a strategic plan to realize this vision.

During the reporting period, the research in the department was organized in four programs: Algebra, Geometry, Analysis, and Stochastics and Operations Research. The quality of the research in each of these programs was judged to be at least satisfactory, and excellent in geometry. Most of the work is in the mainstream of current mathematics research, and some of it is highly relevant for contemporary developments. The Committee was not impressed by the productivity of the programs. Given the implosion of the Analysis program, the Committee refrained from assessing its viability.

In 2000, the department decided to focus its research activities on three themes: computer algebra, mathematical physics, and financial mathematics, with the understanding that if further concentration is needed, the primary focus will be on computer algebra. This choice is motivated by the current participation in international computer algebra projects such as MAGMA. The Committee sees this as a reasonable choice but emphasizes that a mathematics department in a university cannot survive on a single research topic. The education of a future generation of scientists requires a broader-based research program.

The Committee assessed the following research programs:

KUN 01: Algebra
KUN 02: Geometry
KUN 03: Analysis
KUN 04: Stochastics and Operations Research

KUN 01

University	KUN	
Program	Algebra	
Program director	Prof.dr. F. J. Keune	
FTE 2001	1.74	
Assessment	Quality	4
	Productivity	2
	Relevance	4
	Viability	3

Program description/key words:
Polynomial Automorphisms, K-Theory, Computer Algebra

Although the research groups KUN 01 (Algebra) and KUN 02 (Geometry) were presented, interviewed, and judged separately, it is convenient and seems appropriate to make summary comments on the two groups as one.

Committee's comments:

The research groups display significant strengths in certain areas of algebra, number theory, geometry, and related computation. Albeit the best of the algebra and geometry groups is very good indeed, that excellence is relatively narrowly based and is reliant on the output of just a few outstanding individuals, not all of whom will be contributing in the future. Moreover, both in Ph.D. production and in raw output of research papers, the groups performed below par during the reporting period. As noted in our general comments, the department has displayed some suitable efforts to differentiate itself from the other universities by promoting unifying emphases in computer algebra and mathematical physics.

KUN 02

University	KUN	
Program	Geometry	
Program director	Prof.dr. J. H. M. Steenbrink	
FTE 2001	1.04	
Assessment	Quality	5
	Productivity	2
	Relevance	5
	Viability	3

Program description/key words:
Cohomology of Varieties, Lie Theory

The Committee's comments are summarized under research program KUN 01.

KUN 03

University	KUN	
Program	Analysis	
Program director	Prof.dr. A. O. H. Axelsson	
FTE 2001	1.89	
Assessment	Quality	3
	Productivity	3
	Relevance	4
	Viability	Not Applicable

Program description/key words:
Pure Analysis, Numerical Analysis

Committee's comments:

The Analysis group is divided into the two subgroups: Pure Analysis and Numerical Analysis. The leader of the latter subgroup enjoys a strong reputation and takes a visible part in several international research programs. The productivity of the group as a whole was above the statistical national average when measured by the number of publications, but below the average when measured by the number of Ph.D.s. The retirement of the two group leaders and the decision of the university to eliminate the two chairs reduces the viability of the Analysis group practically to zero. When this decision is put into action, the KUN will be the only university among comparable universities in the Netherlands without an Analysis program. Since analysis occupies a central position in the teaching of mathematics, the Committee is uncertain how the education of students in mathematics can be continued (assuming there are such students at all at the moment, which is not evident from the data submitted to the Committee for the assessment). Furthermore, research and education in the physical, biological, and environmental sciences will be at a distinct disadvantage because these disciplines are highly dependent on access to qualified analysts and experts in numerical techniques.

KUN 04

University	KUN	
Program	Stochastics and Operations Research	
Program director	Prof.dr. M. C. A. van Zuijlen	
FTE 2001	1.45	
Assessment	Quality	4
	Productivity	3
	Relevance	4
	Viability	2

Program description/key words:
Mathematical Physics, Financial Mathematics, Mathematical Game Theory

Committee's comments:

The program covers three areas of research: Probability and Mathematical Physics, Game Theory, and Statistics. There has been good work, and some very good in the first subtopic. The staff has undergone significant change, the future of Game Theory is apparently in doubt, and the activities in financial mathematics have been limited by difficulties in attracting personnel. The remaining group contains points of strength but will need support if it is to thrive within the developing environment of the faculty.

3.8 Delft University of Technology, Applied Mathematics Research Program

The Department of Applied Mathematics at Delft University of Technology (Technische Universiteit Delft, TUD) operates within the Faculty of Information Technology and Systems. Key research themes are Algebra and Geometry, Analysis, Numerical Mathematics, Mathematical Physics, Mathematical Systems Theory, Operations Research, Optimization and Risk Analysis, Statistics, and Applied Probability. The mission of the Applied Mathematics Research Program is to make innovative contributions to the mathematical modeling, analysis and control of the complex technical and physical systems that occur in engineering science and technology. The research is mainly driven by technical applications and societal and industrial needs and by opportunities for innovation opened up by advances in mathematics and computing technology.

The mathematics research effort at TUD has, in the perception of the Committee, been affected negatively by several reorganizations during the reporting period. Until 1997, this research was carried out in the Faculty of Technical Mathematics and Informatics (TWI). It covered most of the core areas of mathematics as well as several application areas in statistics and operations research. In 1997, TWI merged with Electrical Engineering to form the new Faculty of Information Technology and Systems (ITS). The three mathematics groups (mathematics, applied analysis, and statistics and operations research) were broken up and distributed over three new departments in ITS: Applied Mathematical Analysis; Mediamatics; and Control, Risk, Optimization, Stochastics and Systems. This reorganization was implemented against the wish of most of the mathematicians at TUD. In the Committee's judgment, the reorganization was disastrous for the mathematics research effort at TUD. The effort lost coherence, and too much emphasis was placed on applications of mathematics in other fields, while core areas of mathematics were ignored. The resulting management structure was unnecessarily complex, with the mathematicians being spread over several institutes, departments, and groups. The Committee was pleased to learn that, in 2002, the decision was made to reverse the situation. With the creation of DIAM (Delft Institute for Applied Mathematics), a Department of Mathematics was re-established in the Faculty of Electrical Engineering, Mathematics, and Computer Science. The Committee supports these changes and endorses the clear mission statement of DIAM. The Committee is shocked, however, by the university's plans to reduce the number of chairs in mathematics, initially to 12 from 15 and eventually to 7.

The fact that during most of the period under review there was no separate Department of Mathematics also affected the quality of the data in the self-assessment report. Data from the third-income stream for mathematics were missing, although it is clear that mathematics generated income from industrial support.

The Committee questions why programs TUD 03 (Numerical Analysis), TUD 04 (Mathematical Physics), and TUD 05 (Mathematical Systems and Simulations) were presented as three separate programs. Joining these programs in one group would have been consistent and might have been beneficial for the coherence of the program.

The Committee is concerned about the decision to discontinue Algebra and Geometry as an independent research program. It is not clear whether this decision is a result of the close cooperation with Leiden University, where this program will be continued, or whether this decision has been taken for other reasons.

The sharp decline in student numbers before 1996 seems to have stopped, but the staffing of the department is still suffering from this earlier decline.

The Committee assessed the following research programs:

TUD 01: Analysis
TUD 02: Algebra and Geometry
TUD 03: Numerical Analysis
TUD 04: Mathematical Physics
TUD 05: Mathematical Systems and Simulation
TUD 06: Probability and Statistics
TUD 07: Mathematical Aspects of Risk Analysis
TUD 08: Optimization Technology

TUD 01

University	TUD	
Program	Analysis	
Program director	Prof.dr. Ph. Clément	
FTE 2001	3.2	
Assessment	Quality	3
	Productivity	3
	Relevance	4
	Viability	4

Program description/key words:
Functional Analysis: Operator Theory, Partial Differential Equations, Deterministic and Stochastic Integral Equations, Quantum Groups; Classical Analysis: Special Functions, Rational Approximation

The Analysis program consists of two subprograms represented by the chairs in Functional Analysis and Classical Analysis. The Functional Analysis subprogram is concerned with operator theory and applications to stochastic evolution equations and elliptic PDEs. The Classical Analysis subprogram is concerned with orthogonal polynomials, special functions, and rational approximations.

Committee's comments:

The leader of the Functional Analysis program enjoys an excellent international reputation. The quality of the group's research and the group's research output, as measured by the publication rate per FTE and the number of Ph.D.s per senior FTE, are good. The group is a node in a Research Training Network of the EU.

The Classical Analysis group did not produce any Ph.D.s during the reporting period.

The Committee feels that mathematical analysis plays a central role in the research and education activities at a technological university such as the TUD. The Committee therefore recommends that, if the university plans to merge the two chairs for Analysis when the leadership of the program passes to the next generation, these plans be discussed at the earliest possible stage and executed with due diligence.

TUD 02

University	TUD	
Program	Algebra and Geometry	
Program director	Prof.dr. J. M. Aarts	
FTE 2001	3.6	
Assessment	Quality	3
	Productivity	2
	Relevance	3
	Viability	Not Applicable

Program description/key words:
Coding Theory, Cryptography, Finite Geometry, Combinatorial Games, Combinatorial Algorithms, Classical Geometry, Tensor Geometry, Dynamical Systems, Coloring of Maps, Compactifications, Ultrafilters

The teaching of mathematics for students of various disciplines is a large part of the duties of the working unit. In order to guarantee the highest standards of teaching, the group must be involved in fundamental research.

Committee's comments:

The Committee understands that this program is being terminated as part of the university's restructuring of its mathematics research and teaching programs. The group has produced research of a satisfactory quality but in rather low quantity and accompanied by an understandably low Ph.D. output.

TUD 03

University	TUD	
Program	Numerical Analysis	
Program director	Prof.dr.ir. P. Wesseling	
FTE 2001	1.4	
Assessment	Quality	4
	Productivity	4
	Relevance	5
	Viability	3

Program description/key words:
Scientific Computing, Numerical Analysis, Computational Fluid Dynamics, Porous Media Flow, Iterative Methods, Parallel Computing

The main thrust of the group's research effort is in the area of computational fluid dynamics, with emphasis on engineering-style analysis and the development of algorithms. Software (SEPRAN, DeFT) is made available to outside users through the Internet and through a spin-off company. A second area of research, flows in porous media, was actively pursued during the period 1997–1999. It was reactivated recently by a newly hired UD whose period in office has been too short for the Committee to see the effect.

Committee's comments:

The leader of the program has a good international reputation. The program's production of Ph.D.s is well above average (as it should be for such an applied field), and its publication rate is slightly above average.

Future research plans are poorly developed; basically, the group wants to stay in the same fields. Mathematical finance is proposed as a new theme, but without any justification. The Committee would have liked to see the rationale for this decision.

The program will face a serious challenge in the near future when its leader retires. Numerical analysis, scientific computing, and computational science and engineering are extremely important areas for both research and education at a technological university such as the TUD. Furthermore, the competition internationally for highly qualified senior researchers in these fields is particularly tough. The Committee urges the TUD to pay serious attention to the leader's succession and recommends that the recruiting process be initiated at the earliest possible date.

TUD 04

University	TUD	
Program	Mathematical Physics	
Program directors	Prof.dr.ir. A.J. Hermans (1996-2001 and Prof.dr.ir. A. W. Heemink (2002)	
FTE 2001	1.6	
Assessment	Quality	3
	Productivity	4
	Relevance	5
	Viability	4

Program description/key words:
Mathematical Modeling, Applied Mathematics, Ordinary Differential Equations, Partial Differential Equations, Integral Equations, Numerical Analysis, Fluid Dynamics, Geophysics

The research in the Mathematical Physics program is strongly motivated by and directed toward applications of analysis to problems in engineering and the physical sciences, such as ship hydrodynamics, hydroelasticity, direct and inverse scattering, and vibrating systems.

Committee's comments:

The group consists of only one professor and three UHDs. However, because of the significant number of Ph.D. students, who are funded externally by Dutch and other international companies and research institutes, the group as a whole is the largest at the TUD, and the number of Ph.D.s produced per academic FTE is among the highest in the Netherlands. In many cases, the final result of a research effort consists of a computer code that can be used by industry, but the group has also produced several articles in reputable journals in applied mathematics.

The development plan describes the immediate future, where the choice of topics will be determined by the needs of research institutes and industry, but does not reflect a long-term vision.

TUD 05

University	TUD	
Program	Mathematical Systems and Simulation	
Program directors	Prof.dr. G. J. Olsder/prof.dr.ir. A.W. Heemink (1996-2001) and prof.dr. G.J. Olsder (2002)	
FTE 2001	2.4	
Assessment	Quality	3
	Productivity	4
	Relevance	4
	Viability	3

Program description/key words:
Systems and Control Theory, Discrete Event Systems, Optimal Control, Differential Games, Inverse Modeling, Large-Scale Systems, High-Performance Computing and Parallel Processing, Data Assimilation

The research can be characterized as applied. Mathematical methods are developed and thoroughly analyzed for a broad range of applications. This includes the development of methods in a number of mathematical disciplines.

Committee's comments:

The Mathematical Systems and Simulation group is the second largest program at TUD. The group published a significant number of papers during the period under review. They cover a wide range of topics at the interface of mathematics and theoretical engineering. The quality of the publications is satisfactory.

The Committee is concerned about the decline in the number of young researchers (Ph.D. students and postdoctoral researchers) and urges the group to make every effort to reverse this negative trend.

TUD 06

University	TUD	
Program	Probability and Statistics	
Program director	Prof.dr. F. M. Dekking	
FTE 2001	3.3	
Assessment	Quality	4
	Productivity	3
	Relevance	5
	Viability	4

Program description/key words:
Markov Processes, Ergodic Theory, Large Deviations, Queuing Theory, Combinatorial Probability, Extreme Values, Inverse Problems, Robust Statistics, Time Series

The mission of the group is twofold: (1) to contribute original high-quality mathematical research to the fields concerned by publishing in high-quality journals and presenting results at international conferences; and (2) to participate in building and analyzing models for a variety of problems from industry and society that require a high level of mathematical expertise.

Committee's comments:

The major thrust of this program lies in stochastics, where there has been much good work, some very good. Some members have high profiles internationally, and they have reported work of high quality on theoretical topics. The poor state of statistics is evident, and the current vacancy in Statistics needs to be filled on a full-time basis. If the TUD is to achieve its mission statement, it will need a healthy program in Statistics, and this may well require further support in addition to a new professor. The low number of completed Ph.D.s may have been influenced by vicissitudes in the pattern of employment.

TUD 07

University	TUD	
Program	Mathematical Aspects of Risk Analysis	
Program director	Prof.dr. R. M. Cooke	
FTE 2001	0.9	
Assessment	Quality	3
	Productivity	4
	Relevance	5
	Viability	4

Program description/key words:
Uncertainty Modeling, Uncertainty Analysis, Consequence Analysis, Expert Judgment

The program is focused on mathematical methods in risk analysis and more generally, decision making under uncertainty. Throughout much of the 1990s, research was directed toward improving the quality of data and data-processing methods in risk analysis.

Committee's comments:

This interesting program has generated very good work in risk analysis. The quality grade of 3 reflects the fact that only limited mathematical originality is needed in this field. The overall impact for applications is, however, much higher than this grade might indicate. There is strong and inspiring leadership, and substantial external funding has been generated. Although the group is small, and in part employed on a part-time contract, it appears to be viable and merits support in the context of the TUD.

TUD 08

University	TUD	
Program	Optimization Technology	
Program director	Prof.dr.ir. C. Roos	
FTE 2001	1.4	
Assessment	Quality	3
	Productivity	4
	Relevance	3
	Viability	3

Program description/key words:
Linear, Convex and Discrete Optimization, Interior-Point Methods, Semidefinite Optimization, Algorithms, Complexity, Computational Logic

The first goal of the group is to make original scientific contributions to the theory and applications of both continuous and discrete optimization. A second goal is to create a visible research environment with active links to the national and international optimization community.

Committee's comments:

This group has concentrated mostly on questions of current interest in optimization and algorithms, and some good work has been done. Limited connections have been made to certain application areas. The group appears viable, but its development and stability in the mid-term will hinge on the refilling of the vacant chair. It would be strengthened through links to cognate areas represented elsewhere in the TUD, including biosciences, probability, and computer science.

3.9 Eindhoven University of Technology, Division of Mathematics

The Division of Mathematics is part of the Department of Mathematics and Computer Science at Eindhoven University of Technology (Technische Universiteit Eindhoven, TUE). The TUE is a research-driven, design-oriented engineering school. Research in mathematics in Eindhoven, while driven by curiosity as everywhere, is inspired by questions of societal and technological relevance. It ranges from fundamental research, ahead of practical demand, to applied research, guiding and validating theoretical investigations.

The Committee commends the TUE for producing a self-assessment report that is well written, factual, and informative. The mission of the university and, by inference, the Mathematics Department is comprehensive and clearly stated.

The Committee notes that, on the basis of the key data provided in the self-assessment reports (total budget for mathematics research, number of academic FTEs), the three technical universities fall roughly into one category. In a comparison, the TUE comes out highest in FTEs for research input, while lowest in total income. The Committee commends the management of the department for its emphasis on a strong and viable research program.

The quality of the research in mathematics at the TUE is satisfactory to excellent. The university has some programs that do outstanding work, some at an international level. The productivity is satisfactory, as measured by both the number of Ph.D.s produced and the number of publications.

The mathematicians at the TUE participate in seven research schools—a strength when it comes to recruiting Ph.D. students for AIO/OIO positions. Nevertheless, the TUE is severely handicapped by low student numbers in mathematics and, more broadly, in the sciences. The Committee has formulated some general observations on this point in Section 2.4.

The mathematicians at the TUE have a long tradition of collaborating with scientists in the Engineering, Material Technology, and Information Technology Departments. The Committee suggests that the mathematicians widen their horizon and also consider the new opportunities arising in the fields of biology and medical engineering, areas in which the TUE has a strong presence. This is a good time for mathematics to reach out to new application areas, and the Division of Mathematics at the TUE should seize the opportunity to expand its research portfolio and broaden the spectrum of career choices for its students.

The Committee welcomes the TUE's policy to strenghten each of the regular chairs with a part-time professor. The eight research groups at the TUE are well endowed with support staff—both system programmers (who also give courses) and secretarial personnel.

The position of chair of Statistics has been vacant for about 2½ years. Two good candidates have declined the position. After the vacancy had been frozen for nine months, the search has now been reopened. The Committee acknowledges the problem of finding qualified researchers for the position.

EURANDOM, a European research institute for the study of stochastic phenomena, is based at the TUE; the Director of EURANDOM occupies the part-time chair of Probability. EURANDOM is an important stimulus for mathematical research; it attracts top researchers, facilitates seminars, and leads to interesting collaborations with Philips and other companies. The joint seminars are important for the mathematicians at the TUE and other universities. The Committee commends the TUE for its support of EURANDOM.

The department houses mathematics as well as computer science. Investments in technical facilities and the library are combined, roughly on an equal basis. The financial position of the department is sound, although the university has some financial problems.

The Committee assessed the following research programs:

TUE 01: Applied Analysis
TUE 02: Scientific Computing
TUE 03: Systems & Control
TUE 04: Statistics & Probability Theory
TUE 05: Stochastic Operations Research
TUE 06: Combinatorial Optimization
TUE 07: Coding Theory & Cryptology
TUE 08: Discrete Algebra & Geometry

TUE 01

University	TUE	
Program	Applied Analysis	
Program directors	Prof.dr.ir. J. de Graaf and prof.dr.ir. C. J. van Duijn	
FTE 2001	3.32	
Assessment	Quality	4
	Productivity	3
	Relevance	5
	Viability	4

Program description/key words:
Analysis of Evolution Equations, Elliptic and Parabolic Free Boundary Problems, Asymptotic and Perturbation Methods, Bifurcation Theory, Homogenization

The group focuses on modeling, analysis of (nonlinear) partial differential equations, and related computational methods. This diverse expertise is applied to a broad spectrum of problems arising in the technical sciences, physics, and industry.

Committee's comments:

The group seems to be in very good shape, working on theoretical problems of operator theory and their applications for PDEs, as well as on concrete problems from continuum physics. The latter component was certainly strengthened by the appointment of the present program director. The group has a remarkably large number of contract research projects. The rate of production of research papers is good. The number of Ph.D.s produced per academic FTE during the reporting period was lower than average, probably because there was only one full professor for almost three years, but this situation seems to have improved recently.

TUE 02

University	TUE	
Program	Scientific Computing	
Program director	Prof.dr. R. M. M. Mattheij	
FTE 2001	2.74	
Assessment	Quality	4
	Productivity	3
	Relevance	5
	Viability	4

Program description/key words:
Partial Differential Equations, Finite Difference Methods, Finite Volume Methods, Modeling of Problems from Industry, Numerical Simulation Tools and Their Analysis

The research of the group finds a major source of inspiration in modeling and numerically simulating problems arising in science and engineering. Its specific role is to develop and analyze better (faster, more efficient, and—if applicable—more stable) methods.

Committee's comments:

The program focuses on numerical methods for problems of continuum physics. The problems are described by partial differential equations, ordinary differential equations, and differential-algebraic equations. Research is motivated by applications in fluid dynamics, combustion, flow of glassy media, flow in porous media, materials processing, and the design of electromagnetic devices. The program is complemented by a software engineering effort to integrate numerical libraries (LAPACK and others) in an object-oriented visual programming environment (VISSION). The program seems well coordinated, with regular interactions among the participants and is a good example of computational science and engineering.

The quality of the research is consistently good. The production of Ph.D.s is satisfactory, but the number of publications is low by international standards in the topic area. The group is well connected nationally and internationally, and the program director enjoys an excellent reputation. The Committee was somewhat puzzled by the fact that the self-assessment report did not mention any interaction with the Applied Analysis program at the same institution (TUE 01). Because much of the research is motivated by practical applications, the group is able to attract significant funding from other sources. Another strength of the program is its ability to attract students from abroad.

TUE has designated materials science and plasmas as two strategic areas of research. The program is well positioned to become a serious player in both arenas.

TUE 03

University	TUE	
Program	Systems & Control	
Program director	Prof.dr.ir. M. L. J. Hautus	
FTE 2001	1.32	
Assessment	Quality	3
	Productivity	3
	Relevance	4
	Viability	Not Applicable

Program description/key words:
Algebraic and Geometric Methods, Behavioral Approach, Systems with Constraints, Hybrid Systems

The aim of systems theory is the development of mathematical theories and methods to treat mathematical models of dynamical systems. The first step is an investigation of the fundamental mathematical description of the common objectives in control theory, such as the realization, identification, regulation, and observation of systems. In addition, efficient methods are sought for achieving these objectives.

Committee's comments:

This program will be closed following the forthcoming retirement of its leader. Despite the long-standing promise of closure, good work has been done, especially by one distinguished member of the group. The rate of production of successful Ph.D.s has been positive but low.

TUE 04

University	TUE	
Program	Statistics & Probability Theory	
Program directors	Prof.dr. P. van der Laan and Prof.dr. W. Th. F. den Hollander	
FTE 2001	1.56	
Assessment	Quality	5
	Productivity	3
	Relevance	4
	Viability	4

Program description/key words:
Nonparametric Statistics, Statistical Process Control, Design of Experiments, Selection Theory, Conditional Inference, Large Deviations, Gibbs Measures, Metastability, Polymers, Long-Range Dynamics, Entropy Production

The program of the stochastics group covers both statistics and probability. The research in statistics has focused on nonparametric statistics, industrial statistics, selection theory, and foundations of statistics. The research in probability centers on stochastic models from statistical physics.

Committee's comments:

This is an active and successful program, which has been substantially reinforced by the proximity of EURANDOM. The achievements in statistics are very good, and in probability good and sometimes excellent. The part time chairholder in Probability has been prominent in a difficult situation. The group, while strong, will be greatly strengthened by the filling of the vacant chair in Statistics. The Committee believes that the strategy of searching for a new professor in either biostatistics or industrial statistics is sound. The number of successful Ph.D.s has been low, reflecting in part the pattern of employment and the vacancy in Statistics.

TUE 05

University	TUE	
Program	Stochastic Operations Research	
Program directors	Prof.dr. J. Wessels and Prof.dr.ir. O. J. Boxma	
FTE 2001	1.65	
Assessment	Quality	4
	Productivity	4
	Relevance	4
	Viability	4

Program description/key words:
Applied Probability, Stochastic Operations Research, Random Walks, Queuing Theory, Performance Analysis

The research program focuses on systems that operate in the presence of randomness. It aims at developing mathematical models and methods for the design, analysis, optimization, and control of such systems.

Committee's comments:

Areas of concentration in this strongly led program include queuing theory, network theory, and performance analysis. These are topics of contemporary relevance, and a variety of valid applications have been considered. Much of the work achieved by the group has been good and sometimes very good. Productivity has been good. The research activities of the group have been substantially aided by the proximity of EURANDOM.

TUE 06

University	TUE	
Program	Combinatorial Optimization	
Program director	Prof.dr. J. K. Lenstra	
FTE 2001	2.08	
Assessment	Quality	5
	Productivity	3
	Relevance	4
	Viability	4

Program description/key words:
Graphs and Matroids, Complexity, Approximation, Enumerative Optimization, Local Search, On-Line Algorithms

The program focuses on fundamental and applied research in optimization, combinatorics, algorithmics, and complexity. It investigates models and methods for discrete planning and design problems that originate in practice, in particular logistics, telecommunication, and biology.

Committee's comments:

The group in Combinatorial Optimization is doing excellent research in relevant areas of combinatorics and theoretical computer science. The output level is satisfactory, and the group's papers appear in leading journals in the respective disciplines. The group has remained strong, despite a significant turnover during the reporting period. It is crucial, however, that the group find a qualified leader who can maintain the level of excellence achieved to date.

TUE 07

University	TUE	
Program	Coding Theory & Cryptology	
Program director	Prof.dr.ir. H. C. A. van Tilborg	
FTE 2001	2.29	
Assessment	Quality	4
	Productivity	3
	Relevance	5
	Viability	4

Program description/key words:
Coding Theory: Constructions, Bounds, Algebraic Geometry Codes, Quasi-Cyclic Codes; Cryptology: Symmetric and Asymmetric Cryptosystems, Secret Sharing Systems, Cryptographic Protocols

The group aims, together with the research school EIDMA, to promote and organize research in discrete mathematics and its applications by enhancing collaboration of its participants, to organize and coordinate the education of young researchers in discrete mathematics and its applications, and to be a natural point of contact for industry.

Committee's comments:

The group members are doing professional work of good quality and enjoy a good international reputation. The intended move to more application-driven research in coding theory has been overtaken by the activities in cryptography. The group uses sophisticated mathematical techniques, and the members' papers appear in leading journals.

TUE 08

University	TUE	
Program	Discrete Algebra & Geometry	
Program director	Prof.dr. A. M. Cohen	
FTE 2001	2.20	
Assessment	Quality	5
	Productivity	3
	Relevance	5
	Viability	4

Program description/key words:
Algebra, Geometry, Discrete Mathematics, Group Theory, Computer Algebra, Incidence Geometry, Extremal Combinatorial Configurations, Design of Experiments, Lie Algebra, Distance-Regular and Distance-Transitive Graphs

The fundamental motivation of the program is the search for discrete structures with certain required properties. These structures range from nice finite geometries to tournament schemes, from configurations in Euclidean space to abstract finite groups.

Committee's comments:

The group is doing high-quality research in the areas of structural algebra and combinatorics. These areas are highly relevant, both from the perspective of the applications and from the internal perspective of mathematics. The group publishes papers in leading journals in the respective disciplines, and many members of the group enjoy an excellent international reputation.

3.10 Twente University, Faculty of Mathematical Sciences

Mathematics research at Twente University (Universiteit van Twente, UT) is concentrated in the Faculty of Mathematical Sciences of the University. The mission statement emphasizes applied mathematics and interdisciplinary research and education. The three research programs in the mathematical sciences submitted for review (Statistics, Operations Research, and Discrete Mathematics; Systems, Signals and Control; and Analysis, Mathematical Physics and Computational Mechanics) are consistent with this mission.

Given the key data in the self-assessment reports (total budget for mathematics research, number of academic FTEs), the Committee considered the three technical universities as a group and noted that, within this group, UT comes out highest in total income but lowest in FTEs for research input. The Committee failed to find a good explanation for this somewhat anomalous situation.

The quality of the research in mathematics at UT is, in the view of the Committee, satisfactory. The three programs operate at a level that one might expect at a university of good standing. The number of Ph.D.s produced is low, but the Committee felt that the total number of technical publications was sufficient to rate the overall productivity as satisfactory.

The mathematicians at UT participate in several research institutes within the university as well as several national research schools. As part of a reorganization initiated in 1999, the department will be integrated either into a new Faculty of Science with Applied Physics and Chemical Technology or into a new Faculty with Computer Science and Electrical Engineering. This reorganization, although forced by financial considerations, may actually strengthen the interactions between the mathematicians and researchers in other disciplines.

The Committee noted that the implementation of a strategic plan, also developed in 1999, has resulted in a concentration of the research programs around seven functional chairs (one of which is currently vacant). The appointment of seven junior researchers at the UD level since 1999 has contributed to a rejuvenation of the department, while a number of part-time temporary positions have been created to compensate for the retirement of some senior researchers. The Committee commends the university for facing its financial difficulties in a constructive manner but notes that the long-term viability of this approach will depend critically on the quality control exercised by the department, especially at the junior level.

The Committee found the self-assessment report submitted by UT very informative but recommends that, on future occasions, the department follow the suggested guidelines for the documentation per program.

The Committee assessed the following research programs:

UT 01: Statistics, Operations Research and Discrete Mathematics
UT 02: Analysis, Mathematical Physics and Computational Mechanics
UT 03: Systems, Signals and Control

UT 01

University	UT	
Program	Statistics, Operations Research and Discrete Math.	
Program director	Prof.dr. W. H. M. Zijm	
FTE 2001	5.8	
Assessment	Quality	3
	Productivity	3
	Relevance	4
	Viability	3

Program description/key words:
Statistics and Probability, Stochastic Models, Discrete Mathematics, Mathematical Programming

The program covers the research of three chairs in Statistics and Probability, Stochastic Operations Research, and Discrete Mathematics & Mathematical Programming. The research is directed toward the design and analysis of mathematical models that support decision making in problems within a societal, economical, or engineering context.

Committee's comments:

Good theoretical results have been obtained within the stochastic subprograms, and the move to stochastic modeling has enabled the group to work on some important applications. The subprogram in Discrete Mathematics has been very active and has published a large number of papers, mostly in good journals. The Committee encourages the subprograms to cooperate more closely while protecting the quantity and quality of the theoretical work in discrete mathematics.

UT 02

University	UT	
Program	Analysis, Math. Physics and Comp. Mechanics	
Program director	Prof.dr.ir. E. W. C. van Groesen	
FTE 2001	5.6	
Assessment	Quality	3
	Productivity	3
	Relevance	4
	Viability	3

Program description/key words:

The program consists of three subprograms: (A) Applied Analysis and Mathematical Physics, (B) Computational Mechanics and Numerical Analysis, and (C) Fundamental Analysis and Algebra. Subprogram (A) focuses on modeling and analysis of nonlinear phenomena, subprogram (B) on numerical methods for problems of continuum physics, and subprogram (C) on problems of mathematical physics. (Here, the term "mathematical physics" is used in the usual sense of algebraic and geometric studies of classical and quantum field theories.)

Committee's comments:

This research program is typical for an applied mathematics department with an engineering orientation.

The group has produced a fair number of Ph.D.s. The quality of the publications is satisfactory, although the number of publications is modest by international standards in applied and computational mathematics. The program coordinator has a good reputation, and several members of the group are active in the profession. Because much of the research is motivated by practical applications, the group is able to attract significant funding from other sources.

Future research plans are poorly developed: less emphasis on fluid dynamics, more emphasis on optics in subprogram (A); continued research along existing lines in subprogram (B); and only a very vague outline of plans for subprogram (C). Future developments for subprogram (C) are particular cause for concern. The Committee feels that a case can be made, especially in mathematics, for supporting fundamental areas of research that are not necessarily multidisciplinary.

UT 03

University	UT	
Program	Systems, Signals and Control	
Program director	Prof.dr. A. J. van der Schaft	
FTE 2001	2.5	
Assessment	Quality	3
	Productivity	3
	Relevance	4
	Viability	4

Program description/key words:
Systems Modeling, Identification and Control, Nonlinear Control Systems, Stochastic Filtering, Distributed Parameter Systems, Robust Control, Mechanical Systems, Hybrid Systems, Financial Mathematics

Systems and control theory deals with the mathematical modeling and analysis of complex dynamical systems composed of interacting subsystems, as well as with their control and synthesis. Various mathematical formalisms are employed, suited to the particular class of systems at hand.

Committee's comments:

This healthy program covers a range of topics in systems and control. The group has produced satisfactory work. The emphasis has been on applicable and applied theory, but the group also has strived to continue its work in basic theory. Future plans include the development of financial engineering, which will be aided by involvement in the universitywide FELab. The level of Ph.D. and postdoctoral activity appears to have been low, but the trend is positive. The program expects to increase the amount of external funding.

3.11 Wageningen University, Discipline of Mathematics

Mathematics research at Wageningen University (Wageningen University and Research Centre, WU) is imbedded in the Department of Plant Sciences (Mathematical and Statistical Methods) and the Department of Social Sciences (Operational Research and Logistics). The research of both groups is performed almost exclusively within the framework of the research schools.

The Committee assessed the following research program:

WU 01: Mathematics

		WU 01
University	WU	
Program	Mathematics	
Program director	Prof.dr.ir. J. Grasman	
FTE 2001	2.8	
Assessment	Quality	3
	Productivity	5
	Relevance	5
	Viability	5

Program description/key words:
Calculus, Applied Mathematics, Mathematical Biology, Descriptive Statistics, Statistical Design, Operational Research

The self-assessment gives the mission of WU as "wanting to help people to obtain sufficient and healthy food in a vital world by means of scientific reseach and education."

Committee's comments:

The mathematics research program is consistent with the stated mission of WU. The program is focused on population dynamics, climate modeling, and the application of operations research and optimization techniques to agricultural production schemes. A new effort was initiated to improve food quality and safety by a dynamic analysis of the food production chain, from seed to consumption.

The group has a significant teaching load within the university. The resources for research are modest but steady. The program is very productive; many dissertations are inspired by problems arising in other departments, and most publications are of a truly interdisciplinary nature and published in the nonmathematical literature. The group provides ample evidence for the fact that there are no limits to the scope of mathematics. The Committee also commends the group for its efforts to involve undergraduates in its research activities.

The program has a well developed plan for the future. The possible establishment of a center for genome research in Wageningen would offer the university a unique opportunity to expand the scope of mathematics and statistics even further.

3.12 Maastricht University, Department of Mathematics

The Department of Mathematics of Maastricht University (Universiteit van Maastricht, UM) is part of the Faculty of General Sciences. All mathematics research is concentrated in the Department.

The Committee assessed the following research program:

UM 01: Mathematics

		UM 01
University	UM	
Program	Mathematics	
Program director	Prof.dr.ir.drs. O. J. Vrieze	
FTE 2001	2.6	
Assessment	Quality	3
	Productivity	3
	Relevance	3
	Viability	3

Program description/key words:
Game Theory, Combinatorial Optimization, Systems and Control, Mathematical Simulation

This program comprises all the activities in the Department of Mathematics.

The department views its mission broadly, from the development of new theories in mathematics to the transfer of mathematical methods to practical problems and stengthening the exact and technological profile of the university. The research program is concentrated in areas of applied mathematics, primarily game theory, combinatorial optimization, systems and control, and mathematical simulation. A new effort in bioinformatics, started in 2000 in cooperation with the Department of Genetics, has not yet led to any measurable output.

Committee's comments:

The group has a significant teaching load within the university. The resources for research are modest but reasonably steady. The department performs at a satisfactory level; it produced 8 Ph.D.s during the period 1996–2002, as well as a number of publications in respectable professional journals. Outreach activities resulted in the establishment of a financially independent business unit (MateUM bv), a daughter of the university holding company (UM Holding), which sells educational and consulting services to industry.

The Committee felt that the department would be well advised to keep its research program focused. The self-assessment report provided by the university did not include a development plan for future research directions. The Committee urges the department to give serious consideration to the development of such a plan and suggests that special care be taken to make the department's research programs relevant for other parts of the university and thereby give it more visibility. The program in bioinformatics may provide a good umbrella for several of the department's research activities.

Appendix 1 Curricula Vitae of Committee Members

Dr. Norbert A'Campo
He received his PhD in Mathematics in 1973 at the Université Paris-Sud at Orsay and was Maitre de Recherche CNRS in 1973-1974. He was speaker at the International Conference of Mathematics in Vancouver in 1974. In the period 1974-1982 he was associate professor at the universities of Paris VII, Paris-Sud and Lausanne to become in 1982 full professor in Mathematics at the University of Basel.
He held since 1973 numerous visiting positions in Europe, USA, China and Japan.

Dr. Geoffrey R. Grimmett
He is the Professor of Mathematical Statistics at the University of Cambridge, where he is currently the Head of the Department of Pure Mathematics and Mathematical Statistics. He works in probability theory with particular interest in problems arising in the rigorous theory of disordered systems, and he is the author of several books on probability including a Springer monograph entitled 'Percolation'.
Professor Grimmett received his doctorate at Oxford University in 1974 under the supervision of John Hammersley and Dominic Welsh. He left Oxford for Bristol, where he became acquainted with many of the realities of contemporary academic life before moving to Cambridge in 1992. He has held visiting posts at universities and institutes in several countries including Australia, France, Germany, Italy, and the USA.

Dr.dr. h.c. Rolf Jeltsch
Dr. Jeltsch received his PhD in Mathematics at ETH Zurich, Switzerland, in 1972. He was Killiam Postdoctoral Fellow at Dahlhousie University in Halifax, Canada, from 1972 to 1973; assistant professor at UCLA, California, from 1973 to 1975; and assistant professor at the University of Kentucky in Lexington, Kentucky, from 1975 to 1976. In 1976 he became docent at the Ruhr University in Bochum, Germany, and associate professor in 1977. From 1979 to 1989 Dr. Jeltsch was full professor and director of the Institute for Geometry and Practical Mathematics at the RWTH, Aachen, Germany. Since 1989 he has been full professor at ETH; and, since 1997, he has been the study director for the curriculum in computational science and engineering.
Dr. Jeltsch is a fellow of the National Mathematical Centre, Abuja, Nigeria, and a foreign member of the Finnish Academy of Science and Letters. He received an honorary degree from the North University of Baia Mare, Romania. He was president of the European Mathematical Society 1999-2002 and the Swiss Mathematical Society 2002-2003. He has chaired the Scientific Council of the Banach Center since 2002 and is advisor to several research institutes in Europe. He is also the director of the ICIAM Congress to be held in Zurich 2007.
Dr. Jeltsch's major research interests are in numerical analysis. In the 1970s, his work centered on ordinary differential equations. Since the 1980s, he has focused on hyperbolic partial differential equations, especially systems of conservation laws with applications. In addition, he conducts large-scale computing in scientific and engineering applications.

Dr. Hans G. Kaper, Chairman
Dr. Kaper received his Ph.D. degree in Mathematics and the Physical Sciences from the University of Groningen, the Netherlands. He has been affiliated with Argonne National Laboratory—a multidisciplinary research laboratory operated by the University of Chicago for the U.S. Department of Energy, located in Illinois—since 1969. He was director of the Mathematics and Computer Science Division of Argonne National Laboratory from 1987 until 1991. He is currently on assignment from Argonne serving as program director for Applied and Computational Mathematics at the National Science Foundation in Washington, D.C. Dr. Kaper has held visiting positions at universities in the U.S., Austria, France, and the Netherlands. He is a corresponding member of the Royal Netherlands Academy of Arts and Sciences. His research interests are in applied mathematics and scientific computing, with emphasis on nonlinear differential equations and their applications.

Dr. Gyula O. H. Katona
Dr. Katona received his diploma in mathematics in 1964 at the Eötvös University, Budapest. He was affiliated with the Research Institute for Telecommunication in Budapest from 1964 until 1966. Since 1966, he has been affiliated with the Mathematical Institute of the Hungarian Academy of Sciences (currently known as the Alfréd Rényi Institute of Mathematics). He received his Ph.D. degree also from Eötvös University in 1968 and the "kandidatus" and "doctor of the Academy" degrees from the Hungarian Academy of Sciences in 1972 and 1981, respectively. He was elected Corresponding Member of the Academy in 1995 and full Member in 2001. He has been the director of the Alfréd Rényi Institute since 1996. Dr. Katona has held visiting positions at the University of Göttingen, Steklov Institute (Moscow) and eight U.S. universities. His research interests are combinatorics and its applications in probability theory and computer science.

Dr. rer.nat.habil. Heinz Langer
Dr. Langer studied mathematics at the TU Dresden, where he received his Ph.D in 1960 and habilitation in 1965. He was professor at TU Dresden from 1966 to 1989. After professorships at Dortmund (1989-2000) and Regensburg (2000-2001), he became O.Univ.Professor for Applicable Analysis at the Vienna University of Technology in 1991, where he has been professor emeritus since October 2003.
His primary research interest is operator theory in Hilbert and Krein spaces and its applications to differential operators and problems of classical analysis.
Dr. Langer is a corresponding member of the Austrian Academy of Sciences.

Dr. Alf J. van der Poorten (AM)
Dr. van der Poorten is emeritus professor of mathematics, Macquarie University, Sydney. He was dean of a divison incorporating departments of mathematics, physics, computing, and electronics from 1980 to 1987 and 1991 to 1996, and chair of the Academic Senate of the University from 1986 to 1987 and 1997 to 2001. He was a faculty member at the University of New South Wales, Sydney, from 1965 to 1978. He has published some 150 papers, primarily on topics with a number-theoretical flavour, and an award winning book *Notes on Fermat's Last Theorem.* He currently works at the Centre for Number Theory Research as an independent mathematical researcher and was director of a university center with that name from 1991 to 2002. He travels extensively, including frequent visits to the Netherlands. His recognitions include the award Doctor honoris causa, Université Bordeaux I 1998, the George Szekeres Medal of the Australian Mathematical Society 2002, and appointment as Member in the Order of Australia (AM) in the Australia day Honours List, 2004.

Appendix 2 Questions Posed by the Committee to Mathematical Institutes

1. The scope of mathematics is expanding. Interdisciplinary and multidisciplinary research projects are becoming increasingly common. Please, give us a brief summary of the interdisciplinary and multidisciplinary research projects your program is currently engaged in.
(To clarify: These projects must involve at least one person in a department other than mathematics, for example, physics, biology, and social and behavioural sciences.) As a quantitative measure, please, provide a list of publications that have appeared in technical journals or refereed conference proceedings during the reporting period that have been co-authored by one of the members of your program and at least one other person in a (named) department other than mathematics at the same or another institution.

2. Students' interest in a research career can be stimulated, for example, by providing opportunities to experience research first-hand. Please, provide a list of publications that have appeared in technical journals or refereed conference proceedings during the reporting period that have been co-authored by one of the members of your program and at least one undergraduate or graduate student.

3. Research can play an important role in the education of a scientifically literate and technically trained workforce. Involving undergraduates in substantial learning through discovery, integrating research and education at the graduate student level, involving postdoctoral associates in the mentoring of graduate and undergraduate students, and developing a team approach to scientific discovery are some of the keys to enhancing the learning experience through research. Please, give a brief description of the efforts to integrate the research and education activities in your program. How successful are these efforts?

4. For the health of the discipline, we need to stimulate interest in our research enterprise among all groups of the population. Research has shown that successful role models and mentoring are particularly important for women. Please, provide a list of women faculty (by rank - HGL, UHD, UD) in your program at the beginning (1996) and at the end (2001) of the reporting period. Please, describe which formal or informal arrangements for mentoring currently exist in your program.

Appendix 3 Programs Submitted for Review and Their Numerical Scores

Legend:
Q (Quality); P (Productivity); R (Relevance); V (Viability)
5 = excellent; 4 = good; 3 = satisfactory; 2 = unsatisfactory; 1 = poor

Code	Research Program	Q	P	R	V
LEI					
LEI 01	Algebra, Number Theory and Geometry	5	3	5	5
LEI 02	Analysis	5	3	5	4
LEI 03	Stochastics	4	3	5	4
UU					
UU 01	Algebra, Geometry and Mathematical Logic	5	3	5	5
UU 02	Analysis	5	3	5	5
UU 03	History of Mathematics	4	3	4	4
UU 04	Stochastics and Decision Theory	5	3	4	5
RUG					
RUG 01	Algebra and Geometry	5	3	5	3
RUG 02	Analysis	4	3	4	NA
RUG 03	Dynamical Systems	4	3	5	3
RUG 04	Systems and Control	5	5	4	3
RUG 05	Probability and Statistics	4	3	4	NA
RUG 06	Computational Mechanics and Numerical Mathematics	3	3	5	3
UvA					
UvA 01	Algebra, Geometry and Mathematical Physics	5	3	5	5
UvA 02	Pure, Applied and Numerical Analysis	4	3	4	4
UvA 03	Stochastics	3	3	4	4
EUR					
EUR 01	Mathematics	3	3	3	3
VU					
VU 01	Analysis	4	3	5	4
VU 02	Geometry	4	3	5	3
VU 03	Stochastics	5	3	5	5

Code	Research Program	Q	P	R	V
KUN					
KUN 01	Algebra	4	2	4	3
KUN 02	Geometry	5	2	5	3
KUN 03	Analysis	3	3	4	NA
KUN 04	Stochastics and Operations Research	4	3	4	2
TUD					
TUD 01	Analysis	3	3	4	4
TUD 02	Algebra and Geometry	3	2	3	NA
TUD 03	Numerical Analysis	4	4	5	3
TUD 04	Mathematical Physics	3	4	5	4
TUD 05	Mathematical Systems and Simulation	3	4	4	3
TUD 06	Probability and Statistics	4	3	5	4
TUD 07	Mathematical Aspects of Risk Analysis	3	4	5	4
TUD 08	Optimization Technology	3	4	3	3
TUE					
TUE 01	Applied Analysis	4	3	5	4
TUE 02	Scientific Computing	4	3	5	4
TUE 03	Systems & Control	3	3	4	NA
TUE 04	Statistics & Probability Theory	5	3	4	4
TUE 05	Stochastic Operations Research	4	4	4	4
TUE 06	Combinatorial Optimization	5	3	4	4
TUE 07	Coding Theory & Cryptology	4	3	5	4
TUE 08	Discrete Algebra & Geometry	5	3	5	4
UT					
UT 01	Statistics, Operations Research and Discrete Mathematics	3	3	4	3
UT 02	Analysis, Mathematical Physics and Computational Mechanics	3	3	4	3
UT 03	Systems, Signals and Control	3	3	4	4
WU					
WU 01	Mathematics	3	5	5	5
UM					
UM 01	Mathematics	3	3	3	3

Appendix 4 Preliminary Assessment Form

REVIEW COMMITTEE MATHEMATICS: PRELIMINARY ASSESSMENT FORM
(Please return to the Secretary of the Review Committee before 15 August 2003)

Title program: **Code:**
First Reviewer: **Filled in by:**
Second Reviewer:

1. Preliminary assessment of the program

Please give your ratings on a 5-point scale, in which
5 = excellent; 4 = good; 3 = satisfactory; 2 = unsatisfactory; 1 = poor

Note: Start from the assumption that all university research should normally conform to a certain standard. Consider whether each aspect of this program is above/on/below this standard. The committee report must specify why deviation of the standard is perceived. Your preliminary assessment is only for use in the committee meetings and will not be published in the committee report.

	1	**2**	**3**	**4**	**5**
A. QUALITATIVE LEVEL					
How do you evaluate the quality of the program with respect to the:					
1. originality of the ideas and the approach					
2. quality of the published output in a foreign language					
3. quality of the published output in the Dutch language; for Dutch understanding reviewers only					
4. prominence of the program director (including the ability to attract research assistants)					
5. prominence of other members of the research group					
6. coherence of the program					
Overall assessment of quality level B. PRODUCTIVITY/OUTPUT					
Considering number of staff, how do you evaluate the productivity of the program with respect to the:					
1. total number of publications					
2. number of publications in a foreign language					
3. number of Ph.D. theses					
4. number of publications in the Dutch language					

	1	2	3	4	5
C. RELEVANCE Considering the stated mission of this program, how do you evaluate the relevance of the research with respect to the:					
1. relevance for the theoretical advancement of the science concerned					
2. relevance for the understanding of major developments in society					
3. relevance for policy					
Overall assessment of relevance D. LONG-TERM VIABILITY					
Considering its personnel and facilities, how do you evaluate the long-term viability of the program					
1. with regard what has been achieved so far					
2. with regard to plans and ideas for the future					
3. in terms of research policy of the program unit					
Overall assessment of long-term viability:					

2. Points of attention/remarks

3. Questions (to the Program Director, Board of Faculty)

Code:
Filled in by:

Appendix 5 List of Abbreviations

AIO	Ph.D. student (Assistent in Opleiding)
EUR	Erasmus University Rotterdam
FTE	Full time equivalent
KNAW	Royal Netherlands Academy of Arts and Sciences
KUN	Nijmegen University
LEI	Leiden University
NWO	Netherlands Research Council
OIO	NWO research assistant (Onderzoeker in Opleiding)
OOW	Overleg Onderzoekscholen Wiskunde
RUG	University of Groningen
TUD	Delft University of Technology
TUE	Eindhoven University of Technology
UM	Maastricht University
UU	Utrecht University
UT	Twente University
UvA	University of Amsterdam
VSNU	Association of Universities in the Netherlands
WU	Wageningen University
VU	Free University Amsterdam