African Institute for Mathematical Sciences
Annual Report 2003/4

(excluding budget)

Executive Summary

This report covers the first year of full operation of the African Institute for Mathematical Sciences (AIMS).

In September 2003, 30 students from 11 countries were admitted to the nine-month postgraduate diploma course. In June 2004, 28 had successfully completed the diploma, while two still need to submit and defend the final form of their essay. Eighteen of the first group of students have now been admitted to Master's and PhD programmes in South Africa.

For the new intake in September 2004, 45 candidates from 18 countries have been selected from 174 applications. Of these 45 candidates, 14 are female and six are serving lecturers at African universities.

Due to a number of generous grants, and due to the commitment of staff and lecturers towards keeping costs low, AIMS finds itself in a healthy financial position. Two items beyond our control did however affect the balance sheet adversely:

1. the fluctuation of the exchange rate resulting in a much stronger South African rand (ZAR) than expected, and
2. very high costs for air tickets from most African countries; which had not been anticipated

The teaching programme during the first year was highly successful, mainly due to the exceptional enthusiasm and quality of the lecturers and the tremendous dedication and commitment of the students. Nevertheless, further improvements are required. With the increase in student numbers from 30 to 45, a dedicated full-time academic staff member is required to ensure continuity between the courses and to monitor individual student performance more closely on a continuous basis. A director of academic studies is being appointed for this reason.

The collaboration with the local universities needs to be improved further. For this, better modes of transport for the AIMS students to and from local university campuses are essential. A vehicle, such as a minibus, needs to be purchased.

The students' and lecturers' meals and accommodation are well organised. However, the limitations of the building's capacity will clearly be reached in 2004/5. With an increasing number of researchers and visitors to AIMS, a second building housing between ten and 20 people urgently needs to be acquired.

AIMS is gaining recognition nationally and internationally, and in particular across Africa, as an important institution serving the mathematical sciences. A cooperation agreement with the African Mathematical Millennium Science Initiative (AMMSI) was reached in June 2004, culminating in a proposal, by several bodies, that this collaboration should become a NEPAD[1] Centre of Excellence.

Further details are to be found in this report and the AIMS web site: www.aims.ac.za.

[1] New Partnership for Africa's Development

Contents

1. Introduction

The African Institute for Mathematical Sciences (AIMS) is a new centre for teaching and research in the mathematical sciences, located in Muizenberg, Cape Town. The AIMS project is an international collaboration between South African and international universities, attracting bright students from all over Africa for an intensive nine-month postgraduate course, taught by outstanding lecturers from all over the world. The AIMS course provides students with an intensive training in research skills as well as exposure to a number of cutting-edge fields. Many of the AIMS students proceed to Master's and PhD programmes and to other technical careers.

AIMS has become established on a very short timescale. The concept was developed in 2001, and participation between the partner institutions was arranged. In 2002 the building was donated, and fund-raising commenced. 2003 was the year of implementation. The AIMS building was refurbished under the supervision of the University of Stellenbosch, and furniture and equipment were purchased. Thirty students were selected out of a total of 85 applicants, five members of staff were employed, and lecturers were selected for specific courses. The teaching programme started in September 2003, at which time a very high-profile launch event was held and attended by African and international scientists. The Minister of Arts, Culture, Science and Technology and the Minister of Education gave presentations.

The first year of teaching went extremely well, and many international visitors commented on the transformation of the students into confident young scientists by the end of the nine months. During this time, several special events were held, including a short course on epidemiological modelling, a mini-symposium on mathematical finance, and a workshop on capacity building in the mathematical sciences in developing countries. These events are discussed in more detail in Appendix A. Many further details can be found on the AIMS web site: www.aims.ac.za. The academic programme ended with a graduation ceremony at the AIMS premises, at which the new Minister of Science and Technology, Mosibudi Mangena, was the guest speaker.

The financial reports are presented in **??** and **??**. These are presented in different forms. The financial year of the University of Stellenbosch coincides with the calendar year and, as this university is responsible for financial management of the AIMS funds including the auditing thereof, the reporting is done in accordance with the calendar year. The academic year of AIMS runs from September to June and therefore the planning and reporting budget is included as an appendix for this cycle. To complicate matters further, AIMS has reporting cycles to the sponsors that are different from the two already mentioned. These reports are presented separately to each of the sponsors as required, but, in order to present the overall picture, the annual report of income and expenses and the planning budgets will also be forwarded to all sponsors.

2. Sponsors

The success of AIMS is only possible because of the enthusiastic support of many people, including organisers and lecturers, and in particular the sponsorship by the following institutions and foundations:

- The Gatsby Charitable Foundation — www.gatsby.org.uk
- The Vodafone Group Foundation — www.vodafonefoundation.org
- The Ford Foundation — www.fordfound.org
- The Andrew W. Mellon Foundation — www.mellon.org
- The Vodacom Foundation, South Africa — www.vodacom.co.za/about
- PetroSA, South Africa — www.petrosa.co.za
- Department of Science and Technology, South Africa — www.dst.gov.za
- The International Council for Science (ICSU) — www.icsu.org
- The International Union for Theoretical and Applied Mechanics (IUTAM) — www.iutam.net
- Cambridge University Press — uk.cambridge.org
- Seardel Investment Corporation Limited, South Africa — www.seardel.co.za
- The University of Stellenbosch — www.sun.ac.za
- Canon Collins Educational Trust for Southern Africa — www.canoncollins.org.uk
- The University of Cambridge Local Examinations Syndicate — www.ucles.org.uk
- The Daniel Iagolnitzer Foundation (Fondation De France)
- The Muizenberg Millennium Education Trust
- The David and Elaine Potter Charitable Foundation
- SUN Microsystems — www.sun.com
- Hyper-Interactive Teaching Technology — www.h-itt.com
- The Victor Rothschild Memorial Fund
- The Ellison Medical Foundation — www.ellisonfoundation.org
- Fred Turok
- Stella Innes, for the donation of the remarkable mathematical research library of her late husband, Evan Innes — www.aims.ac.za/docs/innes.pdf
- British Airways, South Africa Office — www.britishairways.com/travel/home/public/en_za
- European Mathematical Society Committee for Developing Countries
- Jonathan Leake, Sunday Times

More details of the contributions of each sponsor appear in **??** and **??**.

3. People

3.1 The AIMS Council

AIMS is governed by a Council consisting of representatives from each of the participating universities:

- Jan van Bever Donker – University of the Western Cape
- Hendrik Geyer – University of Stellenbosch
- Fritz Hahne – AIMS Director
- Keith Moffatt – University of Cambridge
- Daya Reddy – University of Cape Town
- Graham Richards – University of Oxford
- Neil Turok – University of Cambridge (Chair)
- Vincent Rivasseau – University of Paris-Sud 11

3.2 The AIMS Advisory Board

The Advisory Board advises on all aspects of the AIMS programme, especially its integration with existing courses and research projects in South African and other African universities. Its members are the following:

- Chris Brink – University of Stellenbosch (Chair)
- Nigel Bishop – University of South Africa
- Jat du Toit – University of Potchefstroom
- George Ellis – University of Cape Town
- Barry Green – University of Stellenbosch
- Oluwole Makinde – University of the North
- Jan Persens – University of the Western Cape
- Sibusiso Sibisi – Council for Scientific and Industrial Research
- Patricia Whitelock – South African Astronomical Observatory
- Edmund Zingu – Mangosuthu Technikon

3.3 The AIMS Executive Team

The Executive Team, chaired by the AIMS director, Fritz Hahne, oversees the detailed management and day-to-day running of the AIMS project. Members of the team are listed below:

- Fritz Hahne – AIMS Director
- Neil Turok – Chair of the AIMS Council
- Kristian Müller-Nedebock – University of Stellenbosch
- Jean-Claude Ndogmo – University of the Western Cape
- Gareth Witten – University of Cape Town

3.4 Staff

The director, Prof Fritz Hahne, is employed on a part-time basis of three days per week. He takes overall responsibility for the functioning of the institute. The chair of the AIMS Council, Prof Neil Turok, was closely involved with major decisions that had to be taken throughout the year and through him Council was consulted.

The director is assisted by the staff listed below.

A facility manager, Mr Igsaan Kamalie, resides in the AIMS building and handles operational aspects in connection with the building. His main tasks are accommodation, transport, catering, security, upgrading and maintenance of facilities and equipment, and the well-being of the students and staff living in the building.

The computer officer, Mr Jan Groenewald, has as his main responsibility the maintenance and expansion of the computer infrastructure and control of the IT budget. He monitors digital security, delivers user support, and is partly involved in tutoring the students. He interacts with Mr Carl Scheffler on databases, websites, and documentation for students. Current development projects include clustering, spam blocking, and migrating the server to ensure sufficient space for future years.

The administrative officer, Mrs Mirjam Miske, takes care of correspondence, travel arrangements, all payments, advising students and visitors concerning visa requirements, and all other administrative duties.

Dr Mike Pickles holds a post-doctoral position at AIMS. He studies the applicability of new and old teaching techniques and their relevance to developing communities such as in Africa.

Mr Carl Scheffler is a teaching assistant and develops the various databases and websites.

Mr Emmanuel Kongolo is the general assistant to the facility manager. He also acts as driver, taking students and lecturers to and from the airport and the local university campuses.

3.5 Lecturers

The following academics presented courses to the AIMS students in 2003/4:

- Sanjoy Mahajan – University of Cambridge
- Alan Beardon – University of Cambridge
- Oluwole Makinde – University of the North
- Kesh Govinder – University of KwaZulu-Natal
- Alan Macfarlane – University of Cambridge
- Martin Bucher – University of Cambridge
- David MacKay – University of Cambridge
- Neil Turok – University of Cambridge
- Wayne Getz – University of Berkeley
- Kimber Gross – University of Berkeley
- Jamie Lloyd-Smith – University of Berkeley
- Tadashi Tokieda - City University of New York
- Kavilan Moodley – University of KwaZulu-Natal
- Pedro Ferreira – University of Oxford
- Celine Boehm – University of Oxford
- Kristian Müller-Nedebock – University of Stellenbosch
- Tanniemola Liverpool – University of Leeds
- Ekkehard Kopp – University of Hull
- John Cardy – University of Oxford
- Johann Rohwer – University of Stellenbosch
- Jacky Snoep – University of Stellenbosch
- Daya Reddy – University of Cape Town
- Grae Worster – University of Cambridge
- Arieh Iserles – University of Cambridge
- Dieter Heiss – University of Stellenbosch
- David Aschman – University of Cape Town

Prof Wesley Kotzé, former Head of Mathematics at Rhodes University, coordinated the supervision of the essays and advised the students preparing them.

Prof Nigel Bishop of UNISA was appointed as external examiner and attended most of the final assessments.

The names of the essay topics and supervisors appear in Appendix B.

3.6 Students

The AIMS course officially began on 15 September 2003. The 30 full-time students came from 11 countries, the largest contingent being six students from Nigeria. There were four students from Sudan, three from each of South Africa, Algeria, Zimbabwe, Cameroon and the Democratic Republic of Congo, two from Kenya, and one from each of Malawi, Ghana and Morocco. Seven of the students were women. These students followed the full ten-month course – from September 2003 to June 2004.

In addition, there were four part-time students who followed AIMS courses towards their respective Master's degrees in mathematics at the University of Stellenbosch. One attended the full set of review courses from January to April 2004, and two others followed the three-week long course on financial mathematics. AIMS's computer officer completed the course on geometry and topology. The 34 students are listed below together with their countries of origin.

Algeria
Djalil Ayed
Ilhem Benzaoui
Latifa Bouguerra

Cameroon
Earnest Akofor
Blaise Guy Dongmo
Martin le Doux Mbele Bidima

The Democratic Republic of Congo
Justin Munyakazi Bazimaziki
Pierre Abraham Mulamba Mutombo
Pierrot Musumbu Dibwe

Ghana
Henry Emmanuel Amuasi

Kenya
Timothy Kevin Kuria Kamanu
Davis Bundi Ntwiga

Malawi
Peter Yavizu Mhone

Morocco
Khadija El Boucherfry

Nigeria
Shehu Shuaibu Abdussalam
Eucharia Chimbuzor Nwachukwu
Nneoma Ogbonna
Emmanuel Osalusi
Akwum Agwu Onwunta
Itoro Ubom Udoakpan

South Africa
Louis Brewis (Review courses)
Jan Groenewald (Geometry and Topology)
Gawie Le Roux (Financial Mathematics)
Ashley Marcus (Financial Mathematics)
Lesetsa Jerry Masekela
Sepadi Alfred Motau
Maredi Kenny Mphahlele

Sudan
Mohammed Altaj Mohammed
Ikleel Osman Hamad El Mahadi
Eihab Bashier Mohammed
Zakariya Salih

Zimbabwe
Archiebold Chemwaida Karumbidza
Gift Muchatibaya
Tendai Mugwagwa

Some of the 2003/4 full-time students shortly after arrival

3.7 Researchers

In the past year, the following four researchers were selected from a number of applications to visit AIMS for a period of two months each.

Mr Jonathan Mboyo Esole is a citizen of the Democratic Republic of Congo, currently doing his PhD in The Netherlands at Leiden University. He also studied in Belgium and the UK. His fields of interest are topology, supergravity, M-Theory, BRST cohomology and deformation theory. His visit to AIMS was sponsored by the Ford Foundation.

Mr Aly-Khan Kassam is a UK citizen, but Tanzanian by origin. He is a final-year DPhil student in numerical analysis at Oxford University. His field of interest is numerical solutions to partial differential equations. His visit was sponsored by the Victor Rothschild Memorial Fund.

Mr Benson Muite is a Kenyan citizen, who completed part of his studies in the USA. His field of interest is granular mechanics. His visit to AIMS was sponsored by the Ford Foundation.

Dr Jean Michel Tchuenche came to AIMS from Nigeria. He is a Cameroon citizen, who completed his PhD at the University of Ibadan in Nigeria. His field of interest is biomathematics. His visit was sponsored by the Ford Foundation.

Another researcher, Dr Dominic P Clemence, is expected to visit AIMS from September 2004. His visit will overlap with the new students who are to arrive at AIMS. The visit will be sponsored by the Victor Rothschild Memorial Fund.

4. Academic Programme for 2003/4

At AIMS, the underlying philosophy is to encourage a culture of creative problem-solving, inquiry, and critical understanding. The students have responded with tremendous enthusiasm and dedication to work and this has delighted every lecturer. A compilation of the lecturers' reports on their experience at AIMS is available on request.

The lecturers have, almost without exception, lived in AIMS for the duration of their course, and the students have taken advantage of this by asking questions and gaining understanding over meals, and often well into the night. This has given the institute a unique atmosphere – it is a hothouse for continuous learning.

The style of learning at AIMS is deliberately designed as an antidote to some of the excessively formal learning which occurs in many universities, all over the world, with too great an emphasis on rote learning of formulae and on examination technique. AIMS has quite different goals: to enable students to innovate, solve problems, and to teach in interesting ways which build genuine understanding in new generations.

To do this, the AIMS programme consists of three parts: the skills courses; review courses; and an essay phase. This structure was an experiment, but it was one which worked well. The students appreciated the change in format and style from one course to the next and they enjoyed the variety of subjects taught.

During the first term, the courses focused on developing mathematical skills which are common across all sciences: approximation, problem-solving, computer skills and mathematical modelling, differential equations and linear algebra, and probability and inference. The programme started with approximation and problem-solving, which are unusual, highly engaging courses designed to get the students thinking for themselves, working in groups, using the computers and the libraries, and questioning and discussing everything they learn. A wonderful atmosphere was thereby generated, which all the subsequent lecturers found very stimulating.

In the second term, the review courses each gave a detailed 30-lecture introduction to a different topic in mathematical science: topology, astrophysics, random walks and polymers, financial mathematics, phase transitions, fluid dynamics, numerical analysis, and quantum mechanics. Courses came in pairs, each pair lasting three weeks, and the students had to cover one of the courses from each pair. In fact, many students attended both sets of lectures in a pair.

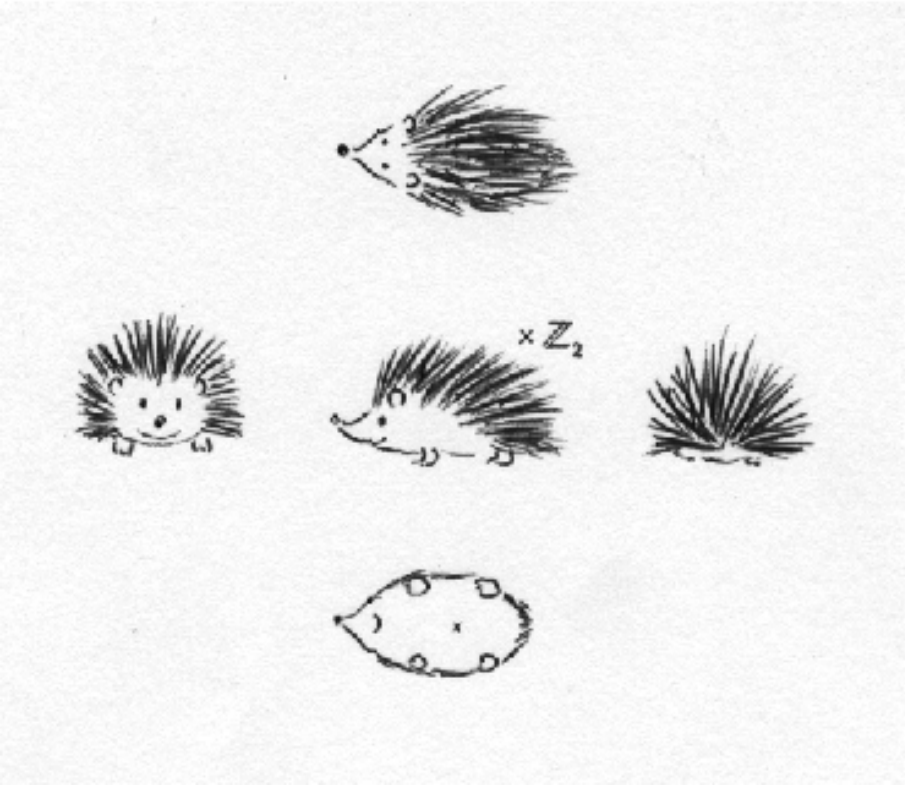
Underpinning the timetable at AIMS are the tutorials. Every afternoon except Wednesdays, the students had extended tutorials on the course, relating to the material covered in the morning lectures. Here they would be set problems or a project, which could be analytic or computational. During the tutorial, they would be assisted by the lecturer for the course, as well as the resident lecturer and other tutors. On occasion, the students would give presentations on what they had done in their project, or on material covered in the course itself, thus helping to develop their presentation skills. Four AIMS students put these skills to the test when they presented work at the South African Society for Numerical and Applied Mathematics annual conference held at the University of Stellenbosch in April. Their talks were extremely well received.

All of these courses made extensive use of the excellent computer facilities at AIMS. During computing classes, the students were exposed to programming in C, Octave and other open-source languages. This was put into practice, for example, during the course on methods, which had all the students simulating and analysing random walks. During the course on information theory, a number of students designed and implemented their own error-correcting codes. These are the very skills which are essential to many high-tech industries.

Formal student feedback about the lectures was obtained for every course. It was, in general, very positive. This has been used to plan the structure of future courses and to make the teaching more relevant to the students.

During the final term, the students each wrote an essay. They chose a supervisor, with whom they would liaise regularly. In preparation, the students were given classes on mathematical writing skills. The final essays were about 30 pages long on average, dealing in depth with a topic of interest to the students. (See Appendix B for the list of topics and supervisors.)

The formal AIMS programme was supplemented by workshops and symposia. For example, during the first week of December, a workshop on epidemiological modelling was held at AIMS. It was attended by the AIMS students and by over 20 students from other parts of South Africa and beyond. The workshop was a great success, in that it supported another new initiative: the South Africa Centre for Epidemiological Modelling and Analysis (SACEMA). A number of AIMS students will be continuing with research in this area and will remain closely linked to SACEMA. (See Appendix A for more on these special events.)



An unusual representation of symmetry, sketched by Tadashi Tokieda, the lecturer for the course on geometry and topology

4.1 Courses and Lecturers 2003/4

Skills Courses 2003/4 All skills courses are compulsory			
Time Period	**No of lectures**	**Lecturer(s)**	**Course Title**
15 Sept – 10 Oct	28	Sanjoy Mahajan	Art of Approximation in Science
15 Sept – 3 Oct	9	Alan Beardon	Mathematical Problem-Solving
13 Oct – 14 Nov	28	Kesh Govinder, Oluwole Makinde	Differential Equations and Mathematical Modelling
6 Oct – 12 Dec	24	Martin Bucher, Alan Macfarlane	Mathematical Methods
17 Nov – 12 Dec	28	David MacKay, Neil Turok	Inference and Information Theory
1 Dec – 5 Dec	9	Wanye Getz	Epidemiology (Tied to workshop)
Review Courses 2003/4 Each student chooses one of two 30-lecture courses in each slot. Short courses are not for credit.			
Time Period	**No of lectures**	**Lecturer(s)**	**Course Title**
5 Jan – 23 Jan	30	Tadashi Tokieda	Topology and Geometry
5 Jan – 23 Jan	30	Pedro Ferreira, Kavilan Moodley	Astrophysics and Cosmology
5 Jan – 23 Jan	5	Celine Boehm	Topics in Astroparticle Physics (Short Course)
26 Jan – 13 Feb	30	Kristian Müller-Nedebock, Tannie Liverpool	Random Walks, Polymers and Biopolymers
26 Jan – 13 Feb	30	Ekkehard Kopp	Financial Mathematics
23 Feb – 12 Mar	30	John Cardy	Phase Transitions and Critical Phenomena
23 Feb – 27 Feb	10	Johann Rohwer, Jacky Snoep	Modelling of Metabolic Pathways
1 Mar – 5 Mar	10	Daya Reddy	Fluid Dynamics I
8 Mar – 12 Mar	10	Grae Worster	Fluid Dynamics II
15 Mar – 2 Apr	30	Arieh Iserles	Numerical Analysis
15 Mar – 2 Apr	30	Dieter Heiss	Quantum Mechanics
15 Mar – 2 Apr	6	David Aschman	Symmetry in Particle Physics (Short Course)

5. Academic Programme for 2004/5

5.1 Student Admissions

In total, 174 applications were received for the AIMS 2004/5 intake, which is more than double the number of applications received for 2003/4. There were 148 male applicants and 26 female ones.

The selection process was done by the AIMS Executive Team. In view of the excellent quality of the applicants, it was decided to select 45 students (rather than 40, as was envisaged in the original business plan). These students, 31 males and 14 females, come from 18 African countries.

5.2 Courses and Lecturers 2004/5

The academic programme for 2004/5 is structured similarly to that of AIMS's first year of operation. The programme for the skills courses in the first term is as below. In addition, there will be discussion classes on concepts in physics. A language skills course will also be presented. During the second term, each student must select at least four (but preferably five) of the nine available review courses.

Skills Courses 2004/5 All skills courses are compulsory			
Time Period	**No of lectures**	**Lecturer(s)**	**Course Title**
6 Sept – 12 Sept	6	Jan Groenewald, Mike Pickles, Carl Scheffler	Introduction to the Computing Facilities at AIMS: GNU/Linux
6 Sept – 3 Oct	17	Alan Beardon	Mathematical Problem-Solving
6 Sept – 3 Oct	17	Sanjoy Mahajan	The Art of Approximation
4 Oct – 25 Oct	15	Alan Macfarlane	Mathematical Methods
4 Oct – 25 Oct	15	Malcolm Macfarlane	Programming and Computer Skills
25 Oct – 31 Oct			Reading week
1 Nov – 21 Nov	25	Neil Turok, Robert de Mello Koch	Electro-Magnetic Theory and Special Relativity
8 Nov – 29 Nov	15	Jacek Banasiak	Difference and Differential Equations and Mathematical Modelling
22 Nov – 13 Dec	15	David MacKay	Inference and Information Theory
29 Nov – 20 Dec	15	Kimber Gross	Epidemiological Modelling
20 Dec – 27 Dec			Reading week

6. Facilities

6.1 Accommodation and Meals

AIMS is housed in a beautiful art-deco hotel which was refurbished for this purpose, barely in time for the intake of the first cohort of students in September 2003.

The two top floors of the four-storey building consist of bedrooms for students and visiting lecturers. The second floor houses the computer lab, the library, and offices used by staff, lecturers and visiting researchers. The lecture room, dining room, living room, kitchen, and laundry are to be found on the ground floor. An enclosed parking area is adjacent to the main building. There is a roof garden on the second level.

The building can house about 60 people and this capacity will be reached in 2004/5. As AIMS is expanding, it becomes a priority to find another building. Muizenberg is being redeveloped rapidly and it is highly likely that accommodation will become much more expensive in future. It is therefore an opportune time to acquire an additional building. This should be within walking distance of the main building.

The kitchen service has been outsourced. Kagiso Khulani Supervision (part of the Compass Group) prepares three meals per day and also handles the cleaning service. Both services are to the overall satisfaction of AIMS and will be continued.

Transport to the airport and to the local universities keeps the staff occupied. AIMS needs to purchase a vehicle in which about 15 students can be transported at the same time.

The maintenance of the building will need constant attention because it is an old building and close to the ocean.

6.2 Computers

The exceptional computational facilities at AIMS were utilised successfully during the first academic year and alumni are able to use these facilities long after they have departed from AIMS.

6.2.1 Hardware

SUN Microsystems donated four servers, two of which are currently being used, one as a firewall and another as a general file/mail/web/database server. They are very reliable and various projects are considered for the other two: failover servers; a powerful research machine; a software mirror; or a server in open-source development and research projects.

At the inception of AIMS, 50 Pentium-IV desktop computers were acquired. Later in the year, these were augmented with a further 25. At the moment, the computer lab hosts 46 of these and the remainder are in various offices. Although fully utilised, these desktops computers should prove adequate at least through the 2004/5 academic year.

Currently, clustering options are being investigated. This would ensure greater computational power is available for CPU-intensive work as research groups at AIMS expand. However, these desktops will continue to function as stand-alone systems; the clustering would be transparent to the user.

AIMS has acquired a scanner, a data projector, and four printers – all in regular use. There is also a video camera to tape AIMS lectures for distribution to other countries. Another data projector and wireless equipment are on order.

6.2.2 Software

AIMS promotes free and open-source software, as this gives students skills that they can use and freely propagate in any future endeavours. All servers and clients run on Debian GNU/Linux. The administrative staff also work on this software, using packages such as OpenOffice.

Although most students arrived with little computing experience, often only on a modest Microsoft platform, they quickly learnt to use the large variety of modelling software available on Linux. Since all courses have a large practical component, this has proved invaluable in providing, for example, visualisation tools. These were impressively show-cased by Henry Amausi (one of the students) at the workshop on capacity building for the mathematical sciences in Africa, which AIMS hosted. Many students included numerical simulations on their third-term projects, and were clearly comfortable using a wide range of software.

Students were encouraged and assisted to burn Linux CDs which contain all the software they have used at AIMS. A week was set aside near the end of the year to give the students a chance to experience the installation process. At the time of writing, there had already been feedback from several students who installed Linux at their destinations.

Documentation is now being developed which will be made available freely on the AIMS website. Tutorials form the basis for the introductory "computer week" at AIMS. During this intensive induction session, students are given an overview of available software such as Gnuplot, Octave, Maxima, Xfig and LaTeX[1]. They are taught the basics of command line interfaces and text editing, and are given a short introduction to languages such as C, HTML and, if time allows, Perl or Python. A thorough introduction to programming will be offered in 2004/5, since in 2003/4 students themselves organised informal sessions on advanced aspects of programming in C/C++.

Martin Mbele, Blaise Dongmo, and Itoro Udoakpan explore the rich variety of free and open-source software in AIMS's cutting-edge computer laboratory

[1] This document was prepared using LaTeX.

6.3 Library

The AIMS library contains almost 2,500 books. These books came to AIMS from different sources. Both Cambridge and Oxford University Presses donated a large quantity of new books. Many more were donated to AIMS from the estate of the late Evan Innes, an actuary who had built up a remarkably sizeable collection of mathematics and physics books during his lifetime. Some were gifts from retiring academics, or from the authors of the books themselves. A couple were even donated by students at AIMS.

Although the books are largely on mathematics and physics, there are also sections on other areas of science and economics, as well as small collections on philosophy and political theory. There is also a modest selection of novels.

The library catalogue is based on the US Library of Congress system. One lecturer, Sanjoy Mahajan, wrote a collection of scripts and programs to look up the catalogue information from the database website for any book, using its ISBN. Students and lecturers then formed a continuous chain, entering books into the catalogue, labelling, and shelving them. The majority of the books were catalogued during two evenings. The books that were not present on the Library of Congress database, for instance older books, were entered in by hand later. AIMS intends to improve this software and distribute it freely.

The AIMS library catalogue is available and searchable online at www.aims.ac.za/internal/library.

Abi Cox and Nneoma Ogbonna sort through AIMS's newly acquired books

7. Development of Relations with Similar Initiatives

Many exciting new developments are taking place at present. The most important of these are described below.

A pan-African "knowledge network" of mathematical institutes has been initiated: the African Mathematical Institutes Network (AMI-Net — www.aims.ac.za/docs/AMI-Net.short.pdf). AIMS has accepted a central role as the hub from which the initiative will be launched and where courses in system administration and in the use of free and open-source software designed for mathematical research and scientific modelling will be presented.

Close links have been forged with the African Mathematical Millennium Science Initiative (AMMSI — www.math.ohio-state.edu/AMMSI). This has resulted in a proposal that the AIMS/AMMSI collaboration should be recognised and supported as a NEPAD[1] Centre of Excellence.

AIMS has close ties with the Stellenbosch Institute for Advanced Science (STIAS — www.stias.ac.za) and also especially with the South African Centre for Epidemiological Modelling and Analysis (SACEMA — www.aims.ac.za/sacema) which is presently situated at STIAS.

AIMS is also keenly supported by the six collaborating universities listed below. Ways and means to formalise these relations are under consideration.

- University of Stellenbosch — www.sun.ac.za
- University of Cape Town — www.uct.ac.za
- University of the Western Cape — www.uwc.ac.za
- University of Cambridge — www.cam.ac.uk
- University of Oxford — www.ox.ac.uk
- Paris-Sud 11 — www.u-psud.fr

AIMS and the South African Astronomical Observatory (SAAO — www.saao.ac.za) have common interests and support each other. For instance, they both support the South African National Astrophysics and Space Science Programme (NASSP — www.star.ac.za).

The AIMS Schools Enrichment Centre (AIMSSEC — www.aims.ac.za/aimssec), which is directed by Toni Beardon, presented a professional development course for mathematics teachers at AIMS in July 2004. It will be reported on separately.

[1] New Partnership for Africa's Development — wwww.nepad.org

Appendix A. Special Events

A.1 AIMS Launch

The AIMS launch took place on 18 and 19 September 2003. This event was sponsored by Cambridge University Press, South Africa's Department of Science and Technology, British Airways, and the Africa-America Mathematics Initiative (USAID).

The launch was attended by a number of prominent mathematicians from around the world. Speakers included the following people: Francis Allotey, Michael Berry, Wayne Getz, Martin Rees, James Gates, Patricia Whitelock, JRA Pearson, Toni Beardon, Graham Richards, George Ellis, Maha Mahadevan, Jan Persens, Paulus Gerdes, James Turner, Katepalli Sreenivasan, and Neil Turok.

The three vice-chancellors of the local participating universities were present.

The event was attended by Dr Ben Ngubane, then South Africa's Minister of Arts, Culture, Science and Technology, Rob Adam, this department's director general, and Prof Kader Asmal, then Minister of Education.

The CSIR was represented by Sibusiso Sibisi.

Round table discussions were held on the future of science in South Africa and mathematics education, as well as the role of AIMS in the developing world.

A.2 Short Course on Epidemiological Modelling

A very successful course on epidemiological modelling was held from 1 to 6 December 2003. More than 20 students from other institutions attended. This course was hosted by AIMS in collaboration with the South African Centre for Epidemiological Modelling and Analysis (SACEMA). A team from Berkeley, USA – Wayne Getz, Kimber Gross, and Jamie Lloyd-Smith – presented the course.

A.3 Symposium on Mathematical Finance

From 25 to 29 February 2004, AIMS hosted a visit by eight prominent international mathematicians active in mathematical finance and stochastic analysis. These visitors came from leading universities in the USA, UK, Norway, and Italy.

The talks introduced the students to current issues in research in mathematical finance.

A.4 Workshop on Capacity Building in the Mathematical Sciences

This workshop was hosted at AIMS from 13 to 17 April 2004. It was set up to consider the problems associated with capacity building in mathematics and its applications in the physical and biological sciences and technology. Another intention of the workshop was to investigate the manner in which AIMS is approaching these problems.

This workshop enabled participants to consider the promotion of teaching and research via the Internet in Africa and more widely in the developing world. The activities of AIMSSEC (the AIMS Schools Enrichment Centre) were covered. Discussion was initiated on establishing the AMI-Net network with AIMS as the prototype.

The workshop was sponsored by the International Union of Theoretical and Applied Mechanics (IUTAM) on the basis of a grant awarded by the International Council for Science (ICSU). IUTAM's proposal to ICSU was supported by the following other scientific and national members of ICSU, many of which were represented at the workshop:

- IUGG (International Union of Geodesy and Geophysics)
- IMU (International Mathematical Union)
- IUPAP (International Union of Pure and Applied Physics)
- IUPAC (International Union of Pure and Applied Chemistry)
- IUA (International Union of Astronomy)
- TWAS (Third World Academy of Science)
- National Members: South Africa, Brazil, Netherlands, Egypt, UK

A.5 AIMS Graduation

On Friday 18 June 2004, the AIMS graduation ceremony was held. The ceremony was officially declared a convocation of the Universities Stellenbosch and the Western Cape. In turn speeches from senior representatives of each institution (Universities Cape Town, Stellenbosch and Western Cape) were made. The guest speaker was the honourable Minister Mosibudi Mangena, of the Department of Science and Technology. Many of the academics who had been involved with the AIMS programme throughout the year attended.

Chris Brink, Vice-Chancellor of the University of Stellenbosch, Mosibudi Mangena, South Africa's Minister of Science and Technology, and Neil Turok, Chair of the AIMS Council, enjoy the graduation ceremony

Appendix B. Essays: Topics and Supervisors

Student	Topic	Supervisor
Shehu Shuaibu Abudussalam	Neutrino mass and its implications in cosmology	Celine Boehm
Earnest Akofor	Gauge symmetry and the gauge bosons	David Aschman
Henry Emmanuel Amuasi	The mathematics of holography	Martin Bucher
Mohammed Altaj Mohammed	Multiscale percolation theory	Gareth Witten
Djalil Ayed	Berry phase	Martin Bucher
Justin Munyakazi Bazimaziki	Barrier options	Peter Ouwehand
Ilhem Benzaoui	Elliptic curves and factorisation	Barry Green
Latifa Bouguerra	Models of infectious diseases on networks	Gareth Witten
Blaise Guy Dongmo	The convergence of subdivision schemes with positive mask	Johan de Villiers
Khadija El Bouchefry	Diffraction: limits of the resolving power of an optical instrument	Martin Bucher
Ikleel Osman Hamad El Mahadi	Computer algorithms for sorting	Martin Bucher
Archiebold Chemwaida Karumbidza	Class number in quadratic forms and ideal classes	Arnold Keet
Timothy Kevin Kuria Kamanu	Continuous time limit of the binomial model	Diane Wilcox
Lesetsa Jerry Masekela	Copulas in finance	Jaco Maritz
Martin Le Doux Mbele Bidima	LIBOR market model	Ronald Becker
Peter Yavizu Mhone	Flow in a diverging channel	Oluwole Makinde
Eihab Bashier Mohammed	Computation and synchronisation in complex dynamics networks	Gareth Witten
Sepadi Alfred Motau	Binomial trees implied by call options	Peter Ouwehand
Maredi Kenny Mphahlele	American option in discrete time	Peter Ouwehand
Gift Muchatibaya	Viscous flow between a rotating and a stationary porous disc	Oluwole Makinde
Tendai Mugwagwa	Classical models for the interaction between HIV and the immune system	Gareth Witten
Pierrot Musumbu Dibwe	Single particle motion in deformed potentials	Dieter Heiss
Pierre Abraham Mulamba Mutombo	Parameter effects on the viral set point in HIV infection: A sensitivity analysis approach	Gareth Witten
Davis Bundi Ntwiga	Copulas in finance	Jaco Maritz
Eucharia Chimbuzor Nwachukwu	Application for change of numeraire	Diane Wilcox
Nneoma Ogbonna	Molecular dynamics simulations	Kristian Müller-Nedebock
Emmanuel Osalusi	Incompressible viscous flow in porous media – oil reservoir modelling	Oluwole Makinde
Akwum Agwu Onwunta	Regularity of refinable functions with positive masks	Johan de Villiers
Zakariya Salih	Epidemics on a scale-free network	Gareth Witten
Itoro Ubom Udoakpan	Wall-driven flow in a tube	Oluwole Makinde

Appendix C. Development of Database

A number of local databases have been created at AIMS as the need has arisen. All databases have been developed using free software and open-source tools. They consist of PHP code on a MySQL back-end. The databases are located on the main file/web/email server at AIMS.

C.1 Courses and Lecturers

The course and lecturer database has been in use for approximately 18 months and has been used for two rounds of AIMS course proposals – for the 2003/4 and 2004/5 academic years.

Lecturers sign up with their personal particulars, contact details, and academic and teaching histories. They may then propose, edit, and withdraw both skills and review courses for the next AIMS academic year. AIMS board members have a separate interface to the site, where the lecturer and course records are viewed.

Course selection is made based on this information. Each course proposal contains information on the title, content, motivation, prerequisite knowledge, and technical requirements for a course. The lecturer who proposes a course supplies all of this information and may update it if the course submission deadline has not been passed. Access to the website is restricted so that lecturers can view their own course proposals and profiles only, but the AIMS board has access to all available information. Access to the site is granted with a username and password. The site is currently located at www.aims.ac.za/database.

C.2 The AIMS African Database

This is a large database of universities, academic departments, and researchers across the African continent.

The first phase of development has been completed. African representatives can sign in and add records for universities and university departments in their respective countries. Representatives from five countries have been contacted and the system is currently undergoing a trial run. This database will be extended to keep record of courses, researchers, and publications across the continent. This information will be viewable and searchable. It could be used to search for people, departments, and courses based on field of research, country of origin, etc.

For such a large database, the maintenance and updating of information is even more important and complex than the creation of the database. An automatic notification system will be created to inform the database administrators when information becomes out of date. For example, automatic email requests for updating information can be sent to the representatives.

C.3 Students/Alumni

This database will contain the contact details, current location, and activities of AIMS students past and present. It is still to be developed.

Appendix D. Website Development

The AIMS website, www.aims.ac.za, consists of a number of sections. These are as follows:

- the AIMS website with
  - general AIMS information
  - contact details
  - news and events
  - staff, student, lecturer, and course information
  - application forms for students, researchers, and lecturers
- the AIMS internal site with
  - tutorials and manuals for using the AIMS facilities
  - course notes
  - presentations given at AIMS
- the AIMS library catalogue
- the database interfaces (detailed in Appendix C)
- the AIMSSEC website
- the SACEMA website

The site is currently undergoing restructuring and the organisation of information will change soon.

All of the sections mentioned above are maintained by the AIMS staff, with the following exceptions:

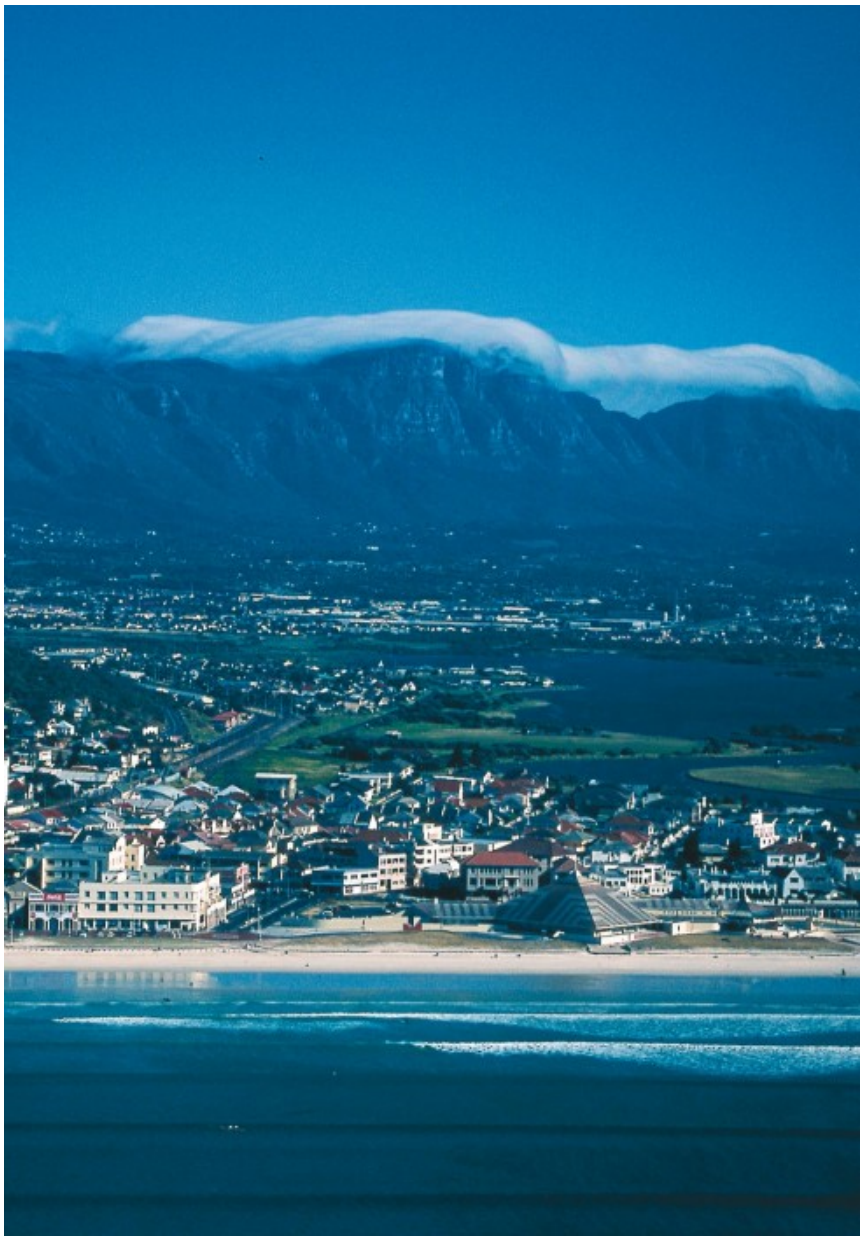
- the AIMSSEC site is maintained by Toni Beardon
- some of the course pages in the internal section of the site are maintained by the respective lecturers

Appendix E. Contact Details

AIMS can be contacted through its website at www.aims.ac.za/english/contact.php, by sending an email to info@aims.ac.za, or by using the physical address below:

Administrative Officer
African Institute for Mathematical Sciences
6-8 Melrose Road
Muizenberg 7945
South Africa

Tel: +27 (21) 787 9320
Fax: +27 (21) 787 9321



A view of Muizenberg village from False Bay — AIMS is located directly behind the beachfront buildings visible bottom left