Review of Activities
of the Centre of Biostochastics (SLU)

Centre of Biostochastics at SLU was created in January 2002. It consists of researchers from Biostokastikum, Umeå at the Department of Forest Economics and from the Section of Biometry at the Department of Biometry and Engineering, Uppsala. The focus is on mathematical and stochastic models and methods to be used in bioscience.

1. **Main Objectives.** The main objectives of the Centre of Biostochastics are:

- **S**timulate the scientific development in mathematics and statistics
- **T**ake actions to improve the quality of applied and theoretical research at SLU
- **P**erform research and methodological development
- **S**trengthen the contacts between researchers at SLU as well as outside SLU
- **E**stablish a graduate school to educate students in mathematical and statistical methods to be used in biosciences
- **P**articipate in interdisciplinary research projects
- **B**e a consultant in mathematics and statistics to PhD students and researchers at SLU
- **T**ake actions to strengthen the field nationally and internationally

The research directions of the Centre of Biostochastics are well selected and belong to very actual directions of modern statistics and biostochastics. At the same time responsibility of the Centre of Biostochastics in the development and realization of educational undergraduate and postgraduate programmes in SLU is not clearly defined, in particular a graduate school not yet having been established.

1. **Organisation.** The Centre of Biostochastics has the Board, the director, the vice director and the staff which includes 21 researchers.

The Board of the Centre includes: Eva Thörnelöf (Chairperson), Administrative Director at MISTRA (The Foundation for Strategic Environmental Research), Stockholm; Jan-Erik Hällgren, Dean, Faculty of Forestry, SLU, Umeå; Hans Liljenström, Professor, Department of Biometry and Engineering, SLU, Uppsala; Bo Ranneby, Professor, Department of Forest Economics, SLU, Umeå; Dietrich von Rosen, Professor, Department of Biometry and Engineering, SLU, Uppsala.

The Director of the Centre of Biostochastics is Professor Bo Ranneby and the Vice Director of the Centre of Biostochastics is Professor Dietrich von Rosen.

The staff of the Centre of Biostochastics includes:

Name	Title	Location
Razaw Al-Sarraj	Postgraduate student	Uppsala
Saeid Amiri	Postgraduate student	Uppsala
Zhanna Andrushchenko	Postgraduate student	Uppsala
Yuri Belyaev	Professor	Umeå
Magnus Ekström	Associate Professor	Umeå
Johannes Forkman	Postgraduate student	Uppsala
Geir Halnes	Postgraduate student	Uppsala
Katarina Huber	Researcher	
Kristi Kuljus	Postgraduate student	Uppsala
Hans Liljenström	Professor	Uppsala
Pia Löthgren	Postgraduate student	Umeå
Kerstin Nordström	Researcher, PhD	
Hans Olofsson	Researcher	
Paolo Piazza	Postgraduate student	
Bo Ranneby	Professor	Umeå
Dilip Roy	Postgraduate student	
Jemila Seid Hamid	Postgraduate student	Uppsala
Tomas Thierfelder	Researcher, PhD	Uppsala
Dietrich von Rosen	Professor	Uppsala
Yingfu Xie	Postgraduate student	Umeå
Jun Yu	Associate Professor	Umeå

There is also a group of guest researchers that took part in the research activities of the Centre of Biostochastics. They are:

S. Rao Jammalamadaka, Professor, Department of Statistics and Applied Probability, University of California at Santa Barbara, USA. October 2004,
Siarhei Minkevich, Doctor of Science, Republic of Belarus. January - July 2004,
Juha Heikkinen, Ph.D., Finnish Forest Research Institute and University of Helsinki, Department of Mathematics and Statistics. February 2005,
Ali Mahdavi, Department of Forest Biometry, University of Freiburg, Germany,
Saeid Amiri, Department of Biostatistics, Medical University of Hamadan, Iran, September-December 2006,
Aila Särkkä, Associate Professor, Department of Mathematical Statistics, Chalmers University of Technology, Göteborg,

Bimal Sinha, Professor, Department of Mathematics & Statistics, University of Maryland, Baltimore County, USA, 2004,
Thomas Mathew, Professor, Department of Mathematics & Statistics, University of Maryland, Baltimore County, USA,
Hannu Oja, Professor, Tampere School of Public Health, University of Tampere, Finland,
Tõnu Kollo, Professor, Institute of Mathematical Statistics, University of Tartu, Estonia,
Tatjana Nahtman, Researcher, Institute of Mathematical Statistics, University of Tartu, Estonia,
Siegfried Kropf, Associate Professor, Institute of Biometry and Medical Informatics, University of Magdeburg, Germany,
Augustyn Markiewicz, Professor, Department of Mathematical and Statistical Methods, The August Cieszkowski Agricultural University of Poznan, Poland,
Ping He, Hong Kong Baptist University, Hong Kong, November 2004,
Bikas K. Sinha, Professor, Math-Stat Division, Indian Statistical Institute, India,
Victoria Litvinova, St. Petersburg State University, Russia, October 2005,
Vadim Abbakoumov, St. Petersburg State University, Russia, January 2006,
Anna Tshirina, St. Petersburg State University, Russia, May 2006.

The Centre of Biostochastics is a research group with well skilled staff of researchers which is well balanced with group of postdoctoral and doctoral students both in Uppsala and Umeå.

2. **Research.** The research activities of the Centre of Biostochastics are realised in the frame of 23 research projects with partial external financing. The results were published in 79 research papers. The researchers affiliated with the Centre of Biostocahstics presented the results at 26 international conferences and workshops and realized 22 research visit abroad. Also 4 PhD Theses and 4 Lic. Theses were prepared and defended.

2.1 Research projects. The research projects realized by the Centre of Biostochastics are:

Statistical inference
Responsible/financier: Centre of Biostochastics, SLU, Umeå
The research has a focus on problems, which are or have an expectation to be typical, at the Faculty of Forestry such as spatial statistics, general methods for statistical inference and sampling methods including non-stationary models in space and time, nearest-neighbour techniques. These methods are applied to classification in image analysis using the wavelet transform and quality assessment of thematic maps using sophisticated resampling methods.

RESE - Remote Sensing for the Environment (1997-2002)
Responsible/financier: MISTRA, The Swedish Foundation for Strategic Environmental Research.
The RESE programme was a unique project where all the major Swedish remote sensing institutions cooperated. The main goal was to improve environmental management and research by developing methods where information from remote sensing satellites is used.

wRESEx - Followup of environmental objectives and preservation strategies for forest and wetland using remote sensing and GIS (2001-2003)
Responsible/financier: MISTRA and the county administrative boards of Dalarna and Gävleborg
Partners: Örebro University, Metria Miljöanalys, County Administrative Boards of Dalarna and Gävleborg

RESAP - Remote sensing for the analysis of environmental pressures from agriculture
Responsible/financier: Swedish National Space Board
Partners: Metria Miljöanalys, County Administrative Board of Dalarna

SAGE - Service for the Provision of Advanced Geo-Information on Environmental Pressure and State
Responsible/financier: ESA - The European Space Agency
This project is one of ten European Space Agency GMES Service Element projects. Swedish Partners: Dept of Environmental Assessment, SLU, Uppsala,The Swedish Environmental Protection Agency, Metria Miljöanalys, County Administrative Board of Dalarna

WFD-REMGIS - The use of remote sensing and GIS for the implementation of the Water Framework Directive
The project is a cooperation between The Swedish Environmental Protection Agency, The County Administrative Board of Dalarna, Metria Miljöanalys, and The Centre of Biostochastics, SLU Umeå.

GEOLAND, EUFP 6 Programme
Swedish partners: Department of Environmental Protection Agency, Metria Milöanalys, Country Administrative Board Dalarna

AGORA for Biosystems
An international forum for experimentalists and theoreticians in the field of biological systems. A world wide network of scientists interested in a dialogue is being created.

Surface-EMG
Responsible/financier: Centre for Biomedical Engineering and Physics / Structural Funds of European Union
The aim of the project is to improve methods for analyzing surface-EMG and to extend the methodology so that it will work as a supplement to the needle-EMG. This project consists of, among others, "Spatial-temporal analysis of multi-channel surface EMG".

Economic valuation of forest assets under conditions of uncertainty
Responsible/financier: SJFR
The goal of this project is to develop an economic evaluation system that is well suited to the special characteristics of forest assets and to investigate proper applications of the developed methods to estimate values of individual forest assets.

Naturliga bakgrundshalter av bly, zink och arsenik i svenska ytvatten
Responsible/financier: Geological Survey of Sweden
Partner: Department of Environmental Assessment, SLU, Uppsala

Utvärdering av statistisk metod för klassning av ekologisk status av vattenförekomst
Responsible/financier: Swedish Environmental Protection Agency
Partner: Department of Aquaculture, SLU, Umeå

QTL analysis
Responsible/financier: Linnaeus Centre for Bioinformatics

Exchange program with Biometry at Otto von Guericke University in Magdeburg
Responsible/financier: STINT

Exchange program with St-Petersburg
Responsible/financier: The Swedish Institute, Visby

Analysis of high-dimensional data
Responsible/financier: The Swedish Research Council

Classification of land use and spatial indicators using satellite images - Innovation, development, and comparison
Responsible/financier: Swedish National Space Board
Partner: Metria Miljöanalys

Clinical EEG analysis and modelling

Partners: Agora for Biosystems (KVA), Sigtuna; Karolinska Institutet, Solna

Risk assessment of chemical substances
Partner: Dept. of Environmental Medicine, Karolinska Institutet.

Computer intensive methods in multivariate analysis
Partner: Dept. of Mathematical Statistics, Uppsala University

Analysis of the coefficient of variation
Partner: Pharmacia & Upjohn

Biostatistical analysis
Partner: Phadia

The Centre of Biostochastics has a very good and representative sample of external research projects which create the base for stable function of the centre, realization of ambitious and diverse research programme.

2.2. Publications. During 2002-2006 the Centre of Biostochastics realized an extensive publication programme. The list of selected publications represented at the web-page of the centre counts 79 items, including one book, 35 papers in international journals. Also 4 PhD theses and 4 Lic. Theses were prepared and defended.

The sample of publications is representative and it is an evidence of goof research productivity of the centre.

2.3. Presentation at conferences and research visits. The results of the research programmes realized at the Centre of Biostochastics have been presented at 26 international conferences and workshops and realized 22 research visit abroad.

This summer school was held at Umeå campus, SLU, Umeå, Sweden, June 6-18, 2004. It is organized by the Centre of Biostochastics at SLU, and funded by NOVA University and NorFA.

The sample of presentations is representative and includes a number of presentations at the most prestigious international conferences. The list of visits includes a sample of leading scientific research centres in the area.

The overall impression about research realised by the centre of Biostochastics is very positive. The research results achieved by the centre correspond to the main objectives and realized at the high research level.

3. Education. The Centre of Biostochastics realises educational activities at undergraduate and postgraduate levels.

3.1. Undergraduate courses. The list of undergraduate courses includes: Multivariate Data Analysis; Regression Analysis and Time Series Analysis; and Spatial Statistics. These are C and D courses delivered in Umeå. The week point is that the Centre of Biostohastics is separated from delivering of basic statistical courses at A and B level both in Umeå and Uppsala and even from delivering of C and D courses in Uppsala. This badly impacts the recruiting students for advanced C u D courses, bachelor and master projects with statistical orientations as well as search of applicants for PhD studies.

Separation of undergraduate education from research and postgraduate education is the most week point in the present situation around the Centre of Stochastics. This badly impacts the recruiting students for advanced C u D courses, bachelor and master projects with statistical orientations as well as search of applicants for PhD studies. The list of undergraduate courses is very short.

3.2. Postgraduate courses. The list of postgraduate courses Analysis of Survival Data, Jackknife and Bootstrap Methods and Their Applications; Mathematics; Multivariate Data Analysis; Spatial Statistics; Statistical Digital Signal Processing; Statistical Methods i Bioinformatics; Wavelets and Multiresolution Signal Processing.

The list of courses is satisfactory. It can be extended and should be connected with the undergraduate courses.

3.3. PhD supervision. 4 PhD theses and 4 Lic. Theses were prepared and defended during the period 2002-2006.

It is worth mentioning that Alex Teterukovskiy was the youngest ever to take a PhD at the Faculty of Forest Science (probably at SLU as a whole but that is not confirmed) and that Jemila Seid Hamid 2006 got Swedish Statistical Association's price as "The young statistician of the year".

The postgraduate supervision process is realized at good level. The list of publications includes satisfactory number of research papers in international journals published by doctoral students. The doctoral students also take an active part in international conferences, workshops and research visit. The supervision process is provided by a good sample of postgraduate courses.

The overall impression about education programme realized by the Centre of Biostochastics is mixed. The postgraduate part is realized at a good level

but the undergraduate part is certainly underdeveloped and the potential of the Centre of Biostochastics is not efficiently used in the undergraduate statistical education.

4. Consultancy and environmental monitoring and assessment. The Centre of Biostochastics realizes consultancy as well as environmental monitoring and assessment activities, in particular, using some support from the SLU and funding given at the moment of creation of the centre. These activities can lead to new external projects and getting additional external support of the centre.

The university has created 10 programs within this area. For design and analysis, these programs require competence in statistics and mathematics. Therefore the Faculty of Forest Science has given 200000 SEK for 2006 and the same amount for 2007 to the Centre of Biostochastics in Umeå to support these projects. So far around 5 projects have presented their problems and been given support.

This is a very prospective direction of activities that should be extended and additionally promoted.

5. Finances. The funding **6** Mkr was given by SLU to the Centre of Biostochastics at the beginning. So far **3.7** Mkr was used. In fact, this funding was used to promote realizations of external projects, in particular by providing a partial support for senior researchers affiliated with the centre as well as junior researchers participating in external projects or PhD projects. This economic way of using available funding should be estimating as an effective way to attract external funding. However, it should be also recognized that total funding planned as 2 Mkr per year for the centre located in Uppsala and Umeå is, in fact, not very impressive. It does not create possibility to support senior researchers as well as PhD students on the regular base and makes the function of the Centre of Biostochastics too much dependent on risky external funding.

This economic way of using available funding should be estimating as an effective way to attract external funding. The overall level of funding is not sufficient. It does not correspond with the positive research results achieved by the Centre of Biostochastics and is not well balanced with the overlapping external finding.

5. Visibility. The activities of the Centre of Biostochastics are well presented at the web-page of the centre as well as in research publications of the centre, and via presentations at international conferences and workshops and research visits.

The information activities of the Centre of Biostochastics are at the appropriate level.

5. Sources of information for the present review. The present review was written on the base of analysis of the report materials submitted by the Director of the Centre of Biostochastics is Professor Bo Ranneby, the examination of the materials represented at the web-page of the centre, analysis of selected publications of the researchers affiliated with the centre, and on the base of the results of discussions with members of the Board of the Centre of Stochastics.

6. Recommendations. The following recommendations may be formulated on the basis of analysis of information available to the reviewer:

- SLU may follow to recommendation from the evaluation performed by the Swedish Agency for Higher Education and to continue to give a financial support to the Centre of Biostochastics, which became one of the concentration and growth points for advanced research at the university;

- The funding of the Centre of Biostochstics should be extended and to regularized on the yearly base. It would be reasonable if this funding would provide a regular support of one senior researcher position in Umeå as well as in Uppsala as well as one doctoral student position yearly;

- The list of undergraduate statistical courses should be enlarged, in particular, in the course of Bologna based transformation of educational programmes at SLU;

- The undergraduate statistical education at A and B levels should be integrated with the educational programmes at C, D, and PhD levels realized by the Centre of Biostochastics, which should take responsibility for the would line of statistical education both at undergraduate and postgraduate levels;

- The PhD educational programme at SLU should include a mandatory statistical course, which would include statistical methods and software, for all PhD students at SLU.

- The Faculties should allocate funding for promotion of very prospective consultancy and environmental monitoring and assessment activities developing by the Centre of Stochastics.

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2007-04-21, Västerås