Evaluation of Mathematics, ICT and Technology (EVALMIT) 2023-2024

Self-assessment for research groups

Date of dispatch: 19 September 2023
Deadline for submission: 31 January 2024

Institution (name and short name): University of Stavanger, UiS
Administrative unit (name and short name): Department of Mathematics and Physics, IMF
Research group (name and short name): Statistics
Date: 31.01.2024
Contact person: Tore Selland Kleppe
Contact details (email): tore.kleppe@uis.no

Content

1. Organisation and strategy

1.1 Research group´s organisation

Describe the establishment and the development of the research group, including its leadership (e.g. centralised or distributed etc.), researcher roles (e.g. technical staff, PhD, post docs, junior positions, senior positions or other researcher positions), the group's role in researcher training, mobility and how research is organised (e.g. core funding organisation versus project based organisation etc.).

The Statistics group is one of 6 research groups at the Department of Mathematics and Physics (the administrative unit). The group is highly cooperative, having a flat organization and consensus-based decision making, rather than a designated leader.

Since the last evaluation of Research in Mathematics at Norwegian Universities, in 2012, the Statistics group has grown from 2.2 to 4.2 senior positions. One senior group member has been the administrative unit's Head of Department since 2018. Two of the 2.2 positions in 2012 are still present. A third full position joined in 2014. An Associate Professor was employed temporarily 2018 - 2021 as a substitute for the Head of Dept and has been employed permanently since 2022. The group size, and recent growth, is mainly determined by the teaching needs in statistics at the Faculty of Science and Technology, where a fair number of engineering students takes statistics courses beyond introductory level, e.g. Data Science, Signal processing, Risk Management, Industrial Economy and various other engineering programs.

The group teaches on the following programmes: the dedicated 5-years Master program in Mathematics and Physics, the 5-years Master Lector program and the oneyear program in mathematics, as well as teaching introductory- and intermediate level courses to a large number of students on other degree programmes at the Faculty of Science and Technology.

As of 2023, the group has educated 2 PhDs to completion, with 2 further PhD students in progress. Additionally, the group has co-supervised 2 post-doc and 5 PhD students admitted to other programmes (in information technology, medicine, economics, statistics). We also provide supervision, advice and consulting to various media, institutions, and research projects outside the department.

The research output of the group typically totals around 10-20 publications in international peer-reviewed journals per year, involving at least one group member. A large portion of these is in medicine-oriented journals (and to some degree other more applied fields). This reflects the groups outward-oriented nature, and the fact that two group members have adjunct positions at Stavanger University Hospital. The group publishes around 3 fully methodology-oriented articles per year.

Each of the senior members of the group have their own independent research agenda, and relatively few publications involve more than one of the senior staff. As such, there is relatively little requirement for leadership/coordination across the senior staff regarding research. Further, each subgroup (senior member and PhD student(s)) is headed, in an informally by the senior member.

The research is largely organized in either, 1) smaller projects with only a handful of individual co-authors either locally, nationally or internationally, or 2) somewhat larger projects involving scientists with different specialties such as medicine, signal processing, engineering and machine learning. Funding is predominantly core funding from UiS. In addition, starting summer of 2023, the group hosts one project from Finansmarkedsfondet (1 PhD student), and group members are also part of externally funded projects hosted elsewhere. With respect to mobility, the group members travel regularly to conferences and shorter-term research stays. Due to family obligations, longer term stays abroad are not common. The group also hosts national and international visitors regularly.

More details like CVs of group members and relevant strategy documents can be found at:

https://www.uis.no/en/about-uis/department-of-mathematics-and-physics/EVALMIT

User: tn-imf@uis.no Password: evalmit

Table 1. List of number of personnel by categories
Instructions: Please provide number of your personnel by categories.
For institutions in the higher education sector, please use the categories used in DBH, https://dbh.hkdir.no/datainnhold/kodeverk/stillingskoder.
Please add new lines or delete lines which are not in use.

	Position by category	No. of researcher per category	Share of women per category (%)	No. of researchers who are part of multiple (other) research groups at the admin unit	No. of temporary positions
No. of Personnel by position	1013 Professor	2	0	0	0
	1011 Associate Professor	2	0	0	0
	1017 PhD student	1	0	0	1
	9301 Professor II*	1	0	0	1

*Professorship (20% position) as a secondary position alongside other main position outside of UiS.

1.2 Research group´s strategy

a) Describe the research group's main goals, objectives and strategies to obtain these (e.g. funding, plans for recruitment, internationalisation etc. within the period 2012-2022.

In research, the primary goal is to maintain and strengthen the group's current position among the top 5 national university research groups in mathematical statistics. To obtain this goal, objectives are:

- Obtaining and maintaining sufficient research time and volume, based on core UiS funding.
- Obtaining further external funding, both by applying on our own, and by partnering with other applicants, nationally and internationally.
- Further strengthen and widen external and internal cooperation, both with methodology-oriented groups and individuals, and by providing statistical expertise to both internal and external research projects in other fields.

Strategies to achieve these objectives include:

- Increasing applications to the RCN and other external funding sources relevant for our activities.
- Applying for internal funding for sabbatical leaves, and to be even more active in establishing collaborations, both within-field and across disciplines.
- Working to grow the group with more permanent members in the long term.

b) Please describe the benchmark of the research group. The benchmark for the research group should be written by the administrative unit in collaboration with the research group. The benchmark can be a reference to an academic level of performance (national or international) or to the group's contributions to other institutional or sectoral purposes.

Example: A benchmark for a research group is related to the research groups' aim which again is included in the strategy for the administrative unit. A guidance for the administrative unit to set a benchmark for the research group(s) can e.g. be: What do the administrative unit expect from the research group(s)?

The benchmarks set for the Research Group follow from the Department strategy document. We indicate for each strategy point the subsections addressing the relevant activities of the group:

Department goal:

* The Department of Mathematics and Physics (IMF) will produce outstanding research and research-based education in mathematics and physics, thereby providing the workforce of the future with both broad and specialized knowledge and skills in the natural sciences.

Overall strategy:

* The IMF will provide a strong academic environment for excellent research in mathematics and physics at the Faculty of Science and Technology (FacST), that is attractive to students and researchers nationally and internationally and contributes to an overall strengthening of the faculty.

Strategy in Research:

* Conduct research to high international standards that is published in highly ranked international journals and that creates visibility and recognition nationally and internationally.

* Strengthen and consolidate the existing academic groups.

* Conduct research that supports the strategic goals of the FacST and the University of Stavanger (UiS), and contributes foundational skills and knowledge that drives and informs the research activities at the other departments at the faculty.

* Continue to attract trend-setting international conferences to the department and increase the number of international and national workshops.

Strategy in Researcher training:

* Offer high-quality Ph.D. education in mathematics and physics, and have an average of at least 15 doctoral students with an average of four dissertations per year (over the entire Department).

Further information may be found in the Strategy documents, available from www.uis.no/en/about-uis/department-of-mathematics-and-physics/EVALMIT. user: tn-imf@uis.no Pwd: evalnat

c) Describe the research group contribution to education (master's degree and/or PhD).

As of 2022, the 23.2 permanent staff positions at the Department of Mathematics and Physics are assigned to 43 lectured course units (10 ECTS or 5 ECTS) each year, as well as 20-30 thesis supervision units (at bachelor and master level). The remaining work time is allocated to research work and administration, including Ph.D. courses and supervision.

The educational activities of the group include:

* Provision of statistics courses at bachelor, master, and PhD level in the following study programs at the department: 1-year program in Mathematics, 5-year secondary education teacher master's degree, 5-year master's in mathematics and physics, and a PhD specialization.

* Provision of courses in statistics to all the engineering and natural science bachelor's degree programs, and a majority of the master programs at the faculty.

* In addition to teaching all statistics courses at Faculty of Science and Technology, the group also contributes towards the pre-engineering mathematics courses.

* In collaboration with Stavanger University Hospital, the group provides two PhD-level courses in statistics for medical researchers.

* The group contributes substantially to the supervision of students on all levels (Bachelor, Master, and PhD).

* Group member Jan Terje Kvaløy is one of only a handful of UiS staff who is a "merited lecturer", and he co-runs a seminar for UiS staff on teaching methods and pedagogics in addition to regular teaching.

Averaged over the department, teaching, research, and administration counts for aproximately 40%, 40% and 20% of the total allocated time. However, the statistics group has a particularly high teaching load with only 10 ECTS courses, multiple courses with many students (1 with around 500 students, 3 with around 150) and high lecturer workloads due to very student-active teaching methods and non-standard evaluation methods. The permanent group members are doing the entire pipeline, course planning, lecturing, and running exercise classes and grading exams and assignments – in some courses with some assistance from student assistants or PhD students.

d) Describe the support the host institution provides to the research group (i.e., research infrastructure, access to databases, administrative support etc.).

The host institution provides funding for:

- Positions, including some PhD positions.
- Resources for travel.
- Access to medium scale (faculty-level) high-performance computing facilities.
- Access to library services, including direct access to the most important journals.
- Proprietary software when needed.
- Administrative support in grant application development.

Very little additional support is sought or needed due to the theoretical nature of the research.

1.3 Relevance to the institutions

Describe the role of the research group within the organisation. Consider the group's contribution towards the institutional strategies and objectives and relate the group`s benchmark to these.

The group is very well integrated into the activities at the Faculty of Science and Technology, both in terms of teaching and research. As described in point 1.2c the group provides statistics courses across the faculty's degree portfolio. The group has research collaborations with most other departments at the Faculty of Science and Technology, and further collaborations with the Faculty of Health Science.

The group's activities contribute towards all three main goals of the UiS' institutional strategy:

- Health & Welfare: Through the group's activities in medical statistics.
- Energy: Through the activities in geophysics and energy economy.
- Learning for life: Through the teaching activities described in §1.2c.

Further, these activities contribute directly to the attainment of faculty strategy goals in "Health & Technology" and "Energy". Additional research collaborations (with researchers at Department of Safety, Economics and Planning and Department of Electrical Engineering and Computer Science at UiS) contribute towards the faculty's strategic goals relating to "Safety" and "Digital technology". Finally, the research group's methodological research and teaching contributes towards attainment of the faculty's strategic goals in "Outstanding research and education."

The group's activities contribute to the department strategy through the benchmarks described in point §1.2b.

1.4 Research group´s resources

Describe the funding portfolio of the research group the last five years (2018-2022).

In general, the unit's economy is based on both basic and external funding.

The funding portfolio for the Department of Mathematics and Physics (the administrative unit) is shown in Table 2. It has not been possible to break down the budget at research group levels. The budget shown is therefore the total budget for the whole unit including all four research groups under evaluation:

- Statistics
- Geometry and Analysis
- Theoretical Subatomic Physics and Cosmology (EVALNAT, 2022)
- Materials Physics (EVALNAT, 2022)

Basic funding primarily covers salary for the 23.2 permanent staff (in 2023). Salary for phds, postdocs and researchers is not included in these numbers.

Table 2. Describe the sources of R&D funding for the research group in the period 2018-2022.

	2018 (NOK)	2019 (NOK)	2020 (NOK)	2021 (NOK)	2022 (NOK)
Basic funding	19 452 000	18 774 000	25 075 000	25 642 000	27 100 000
Funding from industry and other private sector sources	2 313 208	1 859 246	1 350 859	1 081 689	
Commissioned research for public sector					
Research Council of Norway	2 037 358	2 079 239	2 697 328	5 898 485	6 548 230
Grant funding from other national sources					
International funding e.g. NIH, NSF, EU framework programmes					
Other					

1.5 Research group´s infrastructures

Research infrastructures are facilities that provide resources and services for the research communities to conduct research and foster innovation in their fields. These include major equipment or sets of instruments, knowledge-related facilities such as collections, archives or scientific data infrastructures, computing systems communication networks. Include both internal and external infrastructures.

a) Describe which national infrastructures the research group manages or co-manages.

None

b) Describe the most important research infrastructures used by the group**.**

The most important research infrastructures are access to high quality library services and high-performance computing facilities. Currently these services are well provided by the university/faculty.

1.6 Research group´s cooperations

Table 3. Reflect on the current interactions of the research group with other disciplines, non-academic stakeholders and the potential importance of these for the research (e.g. informing research questions, access to competence, data and infrastructure, broadening the perspectives, short/long-term relations).

Interdisciplinary (within and beyond the group)	As mentioned above, individual group members have their own independent research agenda including processes control, time to event data, computational statistics, econometrics and shape analysis. Thus, various fields in statistics are covered by the group, leading to an excellent access of competence within the group. Further, the research group has over a long time had extensive interdisciplinary collaborations with medicine and economy, but also numerous other collaborations such as: numerical analysis, computer science, risk analysis, signal processing and energy research. The interdisciplinary cooperations have to large degree informed research hypotheses with respect to methodological research. Thus, cooperations are crucial to generate research questions with social impact, and to provide data. For example, the research group has active cooperations within: **Medical sciences:** • Biomedical Data Analysis Lab (BMDLab) at Department of Electrical Engineering and Computer Science at UiS • Stavanger University Hospital • Department of Circulation and Medical Imaging, Norwegian University of Science and Technology • Haydom Lutheran Hospital, Tanzania • University of Oslo • Department of Computer Science, University of North Carolina, US **Economics and Econometrics:** • Department of Safety, Economics and Planning at UiS • Faculty of Management, Economics and Social Sciences, University of Cologne, Germany • Department of Economics, Santa Catarina University, Brazil • Department of Economics, Singapore Management University, Singapore **Mathematics/Numerics** (related to Hamiltonian Monte Carlo): • Rutgers University, USA • Stanford University, USA • Flatiron Institute, USA The project funded PhD student is also involved in these cooperations.

Collaboration with other research sectors e.g. higher education, research institutes, health trusts and industry.	The interdisciplinary collaboration is also manifested through collaboration with other partners including industrial partners, e.g.: • Laerdal Global Health, Stavanger (SaferBirth project), • SlicerSalt / Kitware, US (implementation of methodological advancement in shape analysis), • Equinor (geophysics/energy), • Safer, Stavanger. Collaboration within medical science is also manifested by two of the group members having an adjunct position as biostatisticians at Stavanger University Hospital. In addition to collaborating on numerous medical research projects they also provide PhD courses for medical researchers. Furthermore, the research group has recently had collaborations within education research.
Transdisciplinary (including non- academic stakeholders) *Transdisciplinary research involves the integration of knowledge from different science disciplines and (non-academic) stakeholder communities with the aim to help address complex societal challenges.*	In general, it is difficult to differentiate between interdisciplinary and transdisciplinary research collaborations. As described above, research questions within the group are very often motivated by our interdisciplinary cooperations to address societal challenges, e.g., to improve treatment of diseases or medical conditions. An excellent example is our long-standing contribution within the SaferBirth project. Analyses and findings have contributed to reduced newborn and maternal mortality during birth in developing countries. In addition, the group's work within neurodegenerative disease, and economics aims to tackle crucial social challenges.

2. Research quality

2.1 Research group's scientific quality

Describe the research profile of the group and the activities that contribute to the research group´s scientific quality. Consider how the group's work contributes to the wider research within the group's field nationally and internationally.

Despite the small size of the group, its research output is quite diverse. This diversity is both in terms of conducting methodological research in various fields of statistics, and also diversity in terms of doing both theoretical, interdisciplinary and applied research. Some key words for the methodological research areas are computational statistics, time to event data analysis, statistical shape analysis and complex data, statistical process control and Bayesian analysis of multivariate spatial and temporal data. Main areas for the more interdisciplinary and applied work are medical statistics, econometric time series analyses, statistical modelling of meteorological processes and applications in engineering fields like risk analysis and energy research.

The group contribute to the international research community in statistics a steady stream of methodological papers (around 3 per year) in international peer-reviewed journals, while the interdisciplinary and applied work leads to co-authoring around 10-15 papers per year. Between 2018 and 2022, this sums up to 84 papers. One indication of the quality of the work is that around half of the methodological papers are in the highest category (level 2) in the national Norwegian registry of approved publication channels.

Another indication of quality is the group's network of international collaborators.

- Methodological research collaboration partners include: University of Cologne (Germany), University of Göttingen (Germany), Santa Catarina University (Brazil), Seoul National University (South Korea), Tsukuba University (Japan), University of North Carolina at Chapel Hill (USA), Rutgers University (USA), Flatiron Institute (USA), Imperial College (UK), as well as University of Bergen and the Norwegian University of Science and Technology in Norway.
- Inter-disciplinary and applied research collaborations are further detailed in Section 1.6, Table 3.

Further, PhD students (and in exceptional cases also master students) and the active collaborations at local, national, and international level contribute to the group's research output in both methodological and inter-disciplinary/applied research.

Please add a link to the research group`s website:

https://www.uis.no/en/research/mathematical-statistics

Table 4. List of projects

Instructions: Please select 5-10 projects you consider to be representative/the best of the work in the period 1 January 2012 – 31 December 2022. The list may include projects lead by other institutions nationally or internationally. Please delete tables that are not used.

Project 1: *Medical technology (2020-2023)*	**Project owner(s)** (project leaders organisation)	University of Stavanger (Department of Electrical Engineering and Computer Science and Department of Department of Mathematics and Physics)
	Total budget and share allocated to research group	Financing for three PhD students, one allocated to the statistics group. Total around 9 million NOK, of which 3 million NOK to research group.
	Objectives and outcomes (planned or actual) **and link to website**	Development of powerful shape representations and methods for statistical shape analysis to understand risk factors and pathological changes in Parkinson and other neurodegenerative diseases to improve health care for patients. https://github.com/MohsenTaheriShalmani/LP-dss-rep
Project 2: *PhD Project (2016-2020)*	**Project owner(s)** (project leaders organisation)	University of Stavanger, Department of Mathematics and Physics
	Total budget and share allocated to research group	Around 3 million NOK, all allocated to research group.
	Objectives and outcomes (planned or actual) **and link to website**	PhD project for Kjartan Kloster Osmundsen, in the intersection between econometrics and computational statistics.
Project 3: *PhD Project (2017-2020)*	**Project owner(s)** (project leaders organisation)	University of Stavanger, Department of Mathematics and Physics
	Total budget and share allocated to research group	Around 3 million NOK, all allocated to research group.
	Objectives and outcomes (planned or actual) **and link to website**	PhD project for Berent Lunde, in the intersection between machine learning and statistics. Main output: https://github.com/Blunde1/agtboost

Project 4: *Safer Births (2013-2020)*	**Project owner(s)** (project leaders organisation)	Haydom Lutheran Hospital in Tanzania, Safer, Laerdal Global Health, Stavanger University Hospital, University of Stavanger and several others.
	Total budget and share allocated to research group	Several million dollars. Total budget unknown, large collaborative project with many partners. To research group: Travel support and funding of co-supervised PhD student.
	Objectives and outcomes (planned or actual) **and link to website**	Main objective: Reducing newborn and maternal mortality at birth. The group has been involved in analysing data for many of the sub-projects within the Safer Births project. Many of the interventions have been proven to reduce mortality. The original project is finished, but several follow-up projects are ongoing, see https://saferbirths.com/publications/ and https://laerdalglobalhealth.com/partnerships-and-programs/safer-births-research-project/
Project 5: *Safer Births Bundle of Care (2021-2023)*	**Project owner(s)** (project leaders organisation)	Haydom Lutheran Hospital in Tanzania, Safer, Laerdal Global Health, Stavanger University Hospital, University of Stavanger and several others.
	Total budget and share allocated to research group	4.5 million USD. To research group: Travel support.
	Objectives and outcomes (planned or actual) **and link to website**	Main objective: Reducing newborn and maternal mortality at birth. This project aims at scaling up core parts of the Safer Births project (project 4) to many more hospitals in rural parts of Tanzania. The group contribute with data analysis, both for the main project and several sub-projects. https://laerdalglobalhealth.com/Resources/news/safer-births-scale-up/

Project 6: *The North Sea Race Endurance Exercise Study (NEEDED) 2018 (2018-2035)*	**Project owner(s)** (project leaders organisation)	Stein Ørn (project leader) MD, PhD; Stavanger University Hospital; Adjunct Professor at University of Stavanger
	Total budget and share allocated to research group	Total budget: 4 700 000 NOK/year; funds a.o. 1 postdoc and four phd students. Only a minor fraction allocated to research group, for e.g. travels.
	Objectives and outcomes (planned or actual) **and link to website**	Develops new systems to detect heart disease early and find the optimal level of physical activity for the best health benefits. https://www.helse-stavanger.no/fag-og-forskning/forskning-i-helse-stavanger/the-north-sea-race-endurance-exercise-study-needed
Project 7: *The Norwegian ParkWest study (2016-2018)*	**Project owner(s)** (project leaders organisation)	Haukeland University Hospital, Stavanger University Hospital
	Total budget and share allocated to research group	Total budget: 2 750 000 NOK. Only a minor fraction allocated to research group, for e.g. travels.
	Objectives and outcomes (planned or actual) **and link to website**	Identifying markers for progression of Parkinson's disease and to find risk factors for more serious symptom development. https://forskningsprosjekter.ihelse.net/prosjekt/912049
Project 8: *Biomarkers to predict individual risk of dementia in Parkinson's disease (2019 – 2024)*	**Project owner(s)** (project leaders organisation)	Stavanger University Hospital
	Total budget and share allocated to research group	Total budget: NOK 9 380 000 NOK. Only a minor fraction allocated to research group, for e.g. travels.
	Objectives and outcomes (planned or actual) **and link to website**	To uncover prognostic biomarkers for dementia in Parkinson's disease.

Project 9: *Modeling and Empirical Evaluation of Commodity Markets (2016-2019)*	**Project owner(s)** (project leaders organisation)	Department of Safety, Economics and Planning, University of Stavanger
	Total budget and share allocated to research group	Total budget around 8.5 million NOK, covering a PhD and postdoc. Tore Selland Kleppe was co-PI and involved in supervision and research, but no budget was allocated with this.
	Objectives and outcomes (planned or actual) **and link to website**	Development and evaluation of new models for commodity markets, for better understanding such markets.

All publications are availabe in the attached zip folder: UiS_IMF_Statistics_Table5_Publications.zip

Table 5. Research group's contribution to publications

Instructions: Please select 5-15 publications from the last 5 years (2018-2022) with emphasis on recent publications where group members have a significant role. **If the publication is not openly available, it should be submitted as a pdf file attached to the self-assessment.** We invite you to refer to the Contributor Roles Taxonomy in your description: https://credit.niso.org/.
Cf. Table 1. List of personnel by categories: Research groups up to 15 group members: 5 publications. Research groups up to 30 group members: 10 publications. Research groups above 30 group members: 15 publications.
Please delete tables that are not used.

Publication 1: *Connecting the Dots: Numerical Randomized Hamiltonian Monte Carlo with State-Dependent Event Rates/Journal of Computational and Graphical Statistics/2022/ https://doi.org/10.1080/10618600.2022.2066679*	**Authors** (Please highlight group members)	**Tore Selland Kleppe**
	Short description	A new, user-friendly and robust MCMC-like method for complicated target distributions.
	Research group's contribution	All
Publication 2: *A Class of Tests for Trend in Time Censored Recurrent Event Data / Technometrics / 2020 / https://doi.org/10.1080/00401706.2019.1605936*	**Authors** (Please highlight group members)	**Jan Terje Kvaløy** and Bo Henry Lindqvist
	Short description	Presenting a new class of tests for trend in recurrent event data, which include new tests with useful properties, as well as improved versions of previously proposed tests.
	Research group's contribution	Equal share of the work between the two authors, both contributed to all parts. First author came up with the main idea behind the work.

Publication 3: Statistical Analysis of Locally Parameterized Shapes /Journal of Computational and Graphical Statistic*/2022/ https://doi.org/*10.1080/10618600.2022.2116445*/URL*	**Authors** (Please highlight group members)	**Mohsen Taheri** and **Jörn Schulz**
	Short description	Proposing a novel shape representation that is translation and rotation invariant, thereby avoiding dependence on object pre-alignment. A central aspect is the use of a fitted frame at each location in the object interior and boundary.
	Research group's contribution	All
Publication 4: Occult obstructive coronary artery disease is associated with prolonged cardiac troponin elevation following strenuous exercise. European Journal of Preventive Cardiology (EJPC) 2020 https://academic.oup.com/eurjpc/article/27/11/1212/5950974	**Authors** (Please highlight group members)	Øyunn Kleiven, Torbjørn Omland, Øyvind Skadberg, Tor H Melberg, Magnus F Bjørkavoll-Bergseth, **Bjørn Auestad**, Rolf Bergseth, Ole J Greve, Kristin M Aakre and Stein Ørn
	Short description	Sudden cardiac death among middle-aged recreational athletes is predominantly due to myocardial ischaemia. This study examined whether measuring cardiac troponin I and T (cTnI and cTnT) after strenuous exercise could identify occult obstructive coronary artery disease.
	Research group's contribution	Formal Analysis, Methodology, Visualization, Writing – review & editing

Publication 5: Bayesian seismic inversion for stratigraphic horizon, lithology, and fluid prediction /Geophysics/2020/ https://library.seg.org/doi/10.1190/geo2019-0170.1	**Authors** (Please highlight group members)	Odd Kolbjørnsen, **Arild Buland**, Ragnar Hauge, Per Røe, Abel Onana Ndingwan, and Eyvind Aker
	Short description	Efficient methodology for Bayesian prediction of lithology and pore fluid, and layer-bounding horizons, in which we include and use spatial geologic prior knowledge such as vertical ordering of stratigraphic layers, possible lithologies and fluids within each stratigraphic layer, and layer thicknesses.
	Research group's contribution	Conceptualization, methodology, formal analysis, and writing by three first authors (based on long term cooperation between the three first authors also resulting in patent). Further software development mainly by author 4 and 6, and data for case example by author 5.

Table 6. Please add a list with the research groups monographs/scientific books. Max 10 listed: title, first three authors et al and link to webpage (if any).
Please delete lines which are not used.

1	Book: Riemannian Geometric Statistics in Medical Image Analysis, Chapter: Object shape representation via skeletal models (s-reps) and statistical analysis, Authors: Stephen M. Pizer, Junpyo Hong, Jared Vicory, Zhiyuan Liu, J.S. Marron, Hyo-young Choi, James Damon, Sungkyu Jung, Beatriz Paniagua, **Jörn Schulz**, Ankur Sharma, Liyun Tu, Jiyao Wang, Academic Press, 2020, ISBN 9780128147252, https://www.sciencedirect.com/science/article/abs/pii/B9780128147252000145

2.2 Research group´s societal contribution

Describe the societal impact of the group's research. Consider contribution to education, economic, societal and cultural development in Norway and internationally.

The most important societal impact of the group is most likely having educated thousands of students in statistical thinking and methodology – making them more critical and competent in reasoning with data and handling situations with uncertainty. We have in total around 6-800 students completing our courses per year. Providing research-based education, part of this impact can be attributed to our research.

Further our contributions in the many interdisciplinary collaborations imply a certain impact in areas like medicine and economy. Long term impact of this is e.g. contributing to better patient treatment.

Our methodological research might have less immediate societal impact. However, many of our research topics are addressing shortcomings of existing methodology used in the application areas we work with. Thus, there is an impact by providing better analyses in the applications fields in the future. Further, the group has also cooperation with the developers of the Stan Bayesian analysis software on developing improved sampling algorithms, and with developers of the SlicerSALT software (Kitware) on implementing proposed shape models and algorithms. In this regard, the rather theoretical work will potentially be applied by the large number of applied researchers and practitioners currently using the corresponding software.

Other societal contributions are giving outreach talks in various fora and writing dissemination articles in medical newsletters. During the covid-period we developed a dynamic infection trend analysis that was featured on the front page of the main regional newspaper for around a year.

We have also been active in the Norwegian Statistical Association in various ways, e.g. hosting the biannual meeting at one occasion, had the leader of the association for a period and the editorial responsibility for the newsletter. One of the group members has also served on the board of the International Society of Clinical Biostatistics.

Table 7. The research group's societal contribution, including user-oriented publications, products (including patents, software or process innovations

Instructions: Please select 5–10 of your most important user-oriented publications or other products from the last 5–10 years with emphasis on recent publications/products. For each item, please use the following formatting: Please delete lines which are not used.

No.	Name of publication/product	Date of publication/product	Link to the document
1	Pdmphmc (R-package)	2022 and onwards	https://torekleppe.github.io/pdmphmc.doc/
2	R-code for fitting Locally Parameterized Swept Skeletal Structure (LP-dss-rep) to slabular objects	2022 and onwards	https://github.com/MohsenTaheriShalmani/LP-dss-rep
3	Covid infection trend analysis displayed on the front page of aftenbladet.no (the main regional newspaper) for about a year.	2021	https://www.uis.no/nb/statistikere-ved-uis-utviklet-smittetrendanalyse
4	Three dissemination articles on pitfalls and correct use of statistics in medical research.	2021	https://tidsskriftet.no/2021/03/medisin-og-tall/simpsons-paradoks-nar-pluss-og-pluss-blir-minus https://tidsskriftet.no/2021/04/medisin-og-tall/trekantdrama https://tidsskriftet.no/2021/04/medisin-og-tall/statistisk-udodelighet
5	aGTBoost (R-package and documentation)	2020 and onwards	https://github.com/Blunde1/agtboost, see also popular science article: https://www.forskning.no/data-informasjonsteknologi-informatikk/da-the-economist-skulle-finne-noyaktige-tall-for-dodsfall-i-pandemien-brukte-de-metoden-til-norske-berent/1897308
6	Conference of the Norwegian Statistical Association	2019	https://sites.google.com/site/statistiskforening/moeter/stavanger-2019
7	spcadjust (R-package and user article)	2016 (package) and 2017 (user article)	https://cran.r-project.org/web/packages/spcadjust/index.html (package) and https://journal.r-project.org/archive/2017/RJ-2017-014/RJ-2017-014.pdf (user article)
8	Dissemination article on correct use of statistics.	2016	https://www.forskning.no/data-statistikk-media/derfor-ma-du-kunne-statistikk/400798
9	localgauss (R-package and paper)	2013 and onwards	https://cran.r-project.org/web/packages/localgauss/index.html https://www.jstatsoft.org/article/view/v056i12
10	PET (R-package and documentation)	2007 and onwards	https://cran.r-project.org/src/contrib/Archive/PET/ https://cran.r-hub.io/web/packages/PET/PET.pdf

3. Challenges and opportunities

Information about the strengths and weaknesses of the research group is obtained through the questions above. In this chapter, please reflect on what might be the challenges and opportunities for developing and strengthening the research and the position of the group.

With respect to challenges, the group senses that already highly competitive external funding (and also internal funding, beyond current basic funding) for methodological research is getting even more difficult to come by in the current climate. Further, even internal funding for e.g. PhD positions, sabbaticals, travel etc. is reducing as the overall university budget shrinks. The overall negative economic outlook puts forward challenges to development/strengthening of the group.

The group is aware that the University has decided to reduce its total workforce initially, meaning that vacant positions will not automatically be refilled. This may affect the adjunct position which has to be renegotiated periodically.

Further, the funding model for Norwegian universities is changing resulting in increased focus on education. Advanced courses with relatively few students may be discontinued and individual teaching loads may increase further, as resources are re-directed to support bachelor-level courses. Both represent long-term challenges to the research output, external funding and overall standing of the group.

The statistics group has a wide range of possible contact points with other research areas. Statistical expertise plays an increasingly important role in many fields of research, including AI research and applications of AI. The challenge is capacity. The prospects for increased staffing seem bleak in light of the current financial situation at the university. Further, in the light of the mentioned negative outlook within academia, the group is also aware that new position(s) can be difficult to fill as academic positions in statistics to a high degree compete with well-compensated positions outside academia.

The group sees possibilities mostly along three avenues:

- Through further successful applications for external funding could create opportunities for building and extending the group. Such applications should be a mixture of joint projects with researchers in other applied fields and/or industry partners, and more methodology-oriented projects.
- The group already has a wide-ranging international and national network of collaborators, which could possibly be leveraged to a larger degree and further expanded.
- There is also scope for further collaboration nationally, particularly with respect to teaching of more advanced courses. Such a shared model could potentially free up teaching resources across institutions, and at the same time open opportunities to provide a more complete master's degree in statistics.