# FocuStat:

## Focus Driven Statistical Inference with Complex Data

focustat

UiO : **Universitetet i Oslo**

CONTENT:

Cover photo: Paul A. Røstad, 1967.
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FocuStat:

# The Task Force



The core group, at a book discussion evening: G.H. Hermansen, E.Aa. Stoltenberg, V. Ko, S.-E. Walker, B. Cuda, C. Cunen, K.H. Hellton, N.L. Hjort.
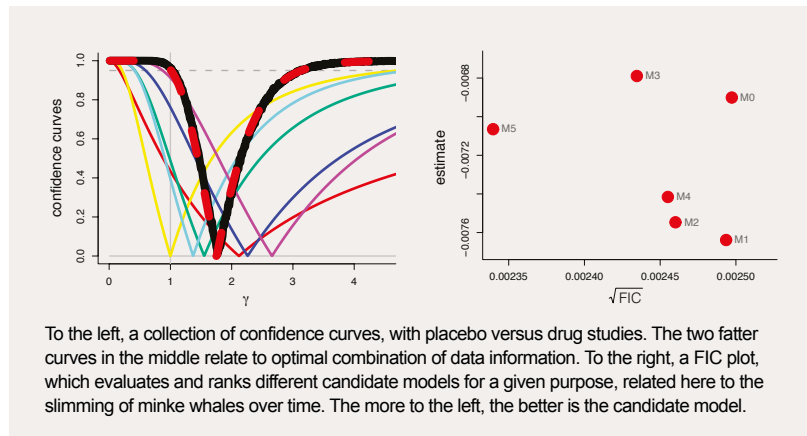
FOCUSTAT HAS BEEN a five-year project within the Statistics Division of the Department of Mathematics, University of Oslo (UiO), funded by the Research Council of Norway, operating from January 2014 to December 2018. The directly funded core group has consisted of Professor Nils Lid Hjort (project leader), Kristoffer Herland Hellton and Gudmund Horn Hermansen (PostDocs), Céline Cunen and Sam-Erik Walker (PhDs).

SEVERAL ASSOCIATED PhD students and Master students, along with further colleagues and collaborators, have also been close to the core group. In particular, PhD students Martin Jullum, Vinnie Ko, Emil Aas Stoltenberg (each supervised or co-supervised by Hjort) have been active participants. Hermansen, Jullum, Cunen defended their PhDs in 2014, 2016, 2018; Ko, Stoltenberg and Walker will defend theirs in 2019. After their PostDoc terms, Hellton is a senior researcher with the Norwegian Computing Centre, Hermansen a First Amanuensis with the BI Norwegian Business School; also, Cunen is from 2019 onwards a PostDoc with the Department of Mathematics, UiO. Former Master students Josephina Argyrou, Jonas Moss, Riccardo Parviero, Leiv Tore Salte Rønneberg (again, supervised or co-supervised by Hjort, and each of them having taken up PhD positions afterwards) have worked with FocuStat related themes, as have Martin Tveten and yet others. For a full list of associated members, consult the Who We Are section at our website.

FocuStat:

# The Tasks and Themes



To the left, a collection of confidence curves, with placebo versus drug studies. The two fatter curves in the middle relate to optimal combination of data information. To the right, a FIC plot, which evaluates and ranks different candidate models for a given purpose, related here to the slimming of minke whales over time. The more to the left, the better is the candidate model.

STATISTICS IS THE science of reaching decisions under uncertainty and is in many respects a far-ranging success story, permeating nearly all substantive sciences and areas of society where data are collected. It has used around hundred years to reach its present state of high maturity and uniform usefulness. In broad strokes, the four main areas associated with

(1) parametrics (models indexed by low-dimensional parameters),
(2) nonparametrics (models with high- or infinite-dimensional parameters),
(3) assessment and selection of models,
(4) combination of different sources of information

drive most of modern statistics, and have, in essence, been well sorted out, conceptually and operationally. There are important gaps to be filled and new paradigms and principles to develop, however, when faced with the statistical challenges of the 21st century. New types of data, related both to new types of substantive questions in a changing society and to evolving technologies for monitoring and examining more complicated phenomena than earlier, create a need for new types of statistical mod-

elling for new types of analysis, and potentially also for new concepts of information and inference. Themes and challenges we have addressed share the concept of *the focus*, the operational view that the science and context drive the most important questions which again should influence the optimal combinations of models, their analysis, and the ensuing decisions. Three such challenges are as follows:

A: "breaking the wall" between areas (1) and (2), partly leaning on recent advances inside area (3).
B: extending the current scope and catalogue of approaches and methods of relevance to area (4), including the use of confidence distributions.
C: extending and developing new methodologies for areas (1) and (3) for the by now frequently occurring situations where the number of measurements per individual exceeds the sample size.

THE RESEARCH AREAS alluded to here are wide and the soil is rich, with many fruitful tasks worthy of detailed study, regarding both methodology and applications. In addition to our individual efforts, sometimes involving two or three of

us in the same sub-project, we have benefitted strongly from our international workshops and research kitchens. We have had such theme-based three-day workshops during the spring semesters of 2015, 2016, 2017, with about 25 participants for each, and smaller-scaled three-day research kitchens during the autumn semesters of 2014, 2015, 2016, 2017, 2018, with up to a dozen participants for each. Also, in May 2018 we organised a somewhat bigger and broader four-day summing-up conference, with about 45 scholars taking part.

THE PRESENT REPORT summarises and documents some of our efforts and achievements. More information and further details may be found at the FocuStat website, which will be kept active and growing also after the formal end of the 2014-2018 project. Importantly, our project has involved work on two fronts, so to speak, with efforts directed both towards developing methodology and towards applying these for substantive questions in real-world application areas. Communication, the task of conveying and interpreting both methodology and application stories to a wider-than-statistics audience, has also been a crucial dimension.

# Focused Statistical Methods

Our FocuStat efforts have had at least two general but correlated dimensions and directions: developing and extending methodology, on one side, and applying the machinery for vital and fruitful application stories, on the other. In this section we give brief one-page summaries of certain methodological endeavours we've contributed to, in different focused directions.

Some of our journal publications by necessity contain mathematical theorem-proof parts, for the specialists, but here we aim at conveying the basic motivation and usefulness of our ideas. These include model building and model selection, confidence curves, change points, personalised medicine, copulae for multivariate dependence, cure models, and robustness.

Céline Cunen:

# Confidence Curves for Dummies

SOME FOCUSTAT MEMBERS have devoted efforts to developing and popularising the concept of the confidene curve. The confidence curve is an inferential summary. It presents the main result of a statistical analysis, for each of the parameters we might be particularly interested in, and constitutes a foundation from which the user can draw real-world conclusions to quantitative problems.

ALL QUANTITATIVE RESEARCHERS are familiar with point estimates, confidence intervals, and p-values. A point estimate is an intelligent guess of the correct value of the parameter in question; a confidence interval gives a set of likely values; a p-value allows the user to conclude a hypothesis test. The confidence curve offers these things, and more.
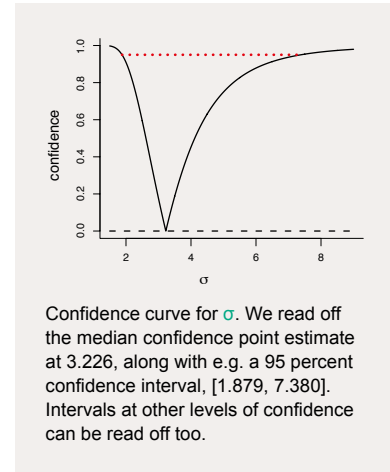
HERE'S A SIMPLE example. You observe the data points 4.09, 6.37, 6.89, 7.86, 8.28, 13.13 from a normal distribution and wish to assess the underlying spread parameter, the standard deviation $\sigma$. The confidence curve, say $cc(\sigma)$, sums up what can be told from the data about that particular parameter. It has candidate values of $\sigma$ on the horizontal axis and level of confidence on the vertical axis. It points to the point estimate (naturally), here 3.226 (which we call the median confidence estimate); we may read off e.g. a 95 percent confidence interval of likely values, here [1.879, 7.380], cf. the red dotted line; intervals for other levels of

confidence may be read off too; and we see the clear asymmetry in how confidence is distributed. In many other cases the confidence curve is symmetric, but here the distribution of the statistic informing us about the size of $\sigma$ has a skewed distribution. The $cc(\sigma)$ can also be used to read off p-values for tests.

AT THE BASIC level the confidence curve is simply a plot of nested confidence intervals at all levels, from 0 to 100 percent. The plot conveys a lot of information quickly and is easy to understand. Some users will interpret this as a distribution of likely values, after seeing the data; it is the canonical frequentist cousin to the Bayesian's posterior density (but there is no prior camel to swallow). It may also have a positive probability mass at a boundary point of the parameter space, e.g. at zero for a variance parameter.

CONFIDENCE CURVES ARE particularly fruitful in the context of meta-analysis, where several sources inform on the same parameter of interest, see the figure on page 3. There we display a confidence curve for the parameter of interest from six different studies, here denoted $\gamma$, and observe that although they inform on the same parameter there are some differences, both in the point-estimates and the uncertainty conveyed by each study. In addition, we also display the combined confidence curve, reflecting the full information about $\gamma$ from all six studies.



Confidence curve for $\sigma$. We read off the median confidence point estimate at 3.226, along with e.g. a 95 percent confidence interval, [1.879, 7.380]. Intervals at other levels of confidence can be read off too.

THE CONFIDENCE CURVE constitutes a step away from classical frequentist testing, where the typical result is simply a decision on whether to reject the null hypothesis or not, based on some 0.05 type significance rule. The confidence curve promotes transparency: given the same model, data, and assumptions, different users should arrive at the same confidence curve, but might nonetheless draw different real-world conclusions in the end. At any rate the use of confidence curves should discourage the automatic use of statistical methods and hopefully encourage critical thinking.

ALL PROCEDURES GIVING rise to confidence intervals can be adapted in order to construct a confidence curve. Various recipes are given in Schweder and Hjort's Confidence, Likelihood, Probability (2016) book, along with theoretical analyses and worked-out examples.
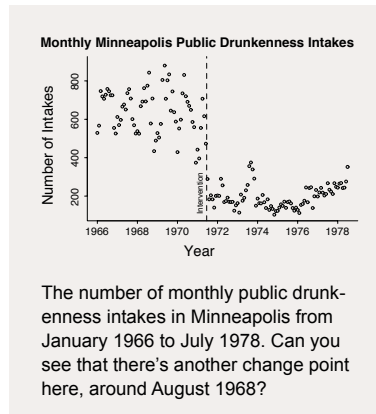
Gudmund Hermansen:

# Change Points in Minnesota

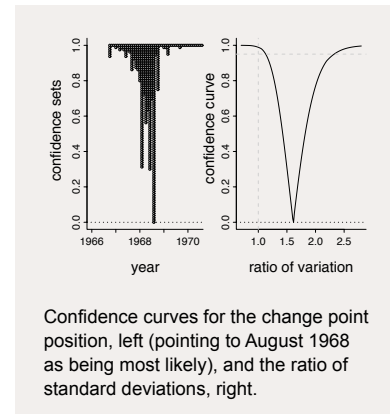IN JUNE 1971 the state of Minnesota changed their law such that public drunkenness and intoxication would not be considered a crime anymore. The intention with decriminalisation was to change how local authorities would treat and take care of individuals with alcohol and drug related problems.

TO IMPLEMENT THE regulatory changes, police were given three choices for dealing with a drunken or intoxicated person in a public place: (i) transport the person to a facility equipped to give emergency care; (ii) take the person home if he is not endangering himself, others, or property; or (iii) leave the person where he is found. More details are given and discussed in Aaronson, Dienes, Musheno (1977). With this in mind, it is important to understand questions such as (1) how did the police react to these changes; (2) were they able to handle the new responsibility; (3) had there been any noticeable changes in behaviour, for the police or for public drinking, before the intervention date June 1971?

TO ADDRESS SUCH questions, consider the numbers of monthly Minneapolis public drunkenness intakes, as displayed in the figure. One does not need to be a statistician to spot the drastic change point in July 1971, before and after the regulatory changes. More refined methods are required when it comes to looking for potential changes in the time period before that. Using methodology developed in our paper



The number of monthly public drunkenness intakes in Minneapolis from January 1966 to July 1978. Can you see that there's another change point here, around August 1968?

Cunen, Hermansen, Hjort (2018), involving also a certain statistical model for these data, we are indeed able to point to August 1968 as another and less visible change point. Additional contextual aspects need to be brought in when attempting to explain or to find proper causes for such statistical change points. The data, when carefully analysed, tell us (a) that something changed around August 1968; (b) the relative degree of that change; (c) how certain we can be regarding such statements; but nothing more, so to speak. This is conveyed via the confidence curves in our figure. Additional information and understanding is required if we wish to go on to point (d), the reasons involved and the background for what we claim is such a change around August 1968. Incidentally, in the article mentioned we apply our methods to changes in the number of skiing days in Nordmarka over the past hundred years, to changes in the liver condition for the Lofoten skrei, again over the past hundred years, and to the change of authorship in the world's first novel (in Catalan, from the 1460ies).



Confidence curves for the change point position, left (pointing to August 1968 as being most likely), and the ratio of standard deviations, right.

ACTUALLY, MANY EVENTS took place and many public debates went on, related to the public use of alcohol and drugs, and the handling of such cases by the police, in the years leading up to the decriminalisation and hence drastic change of police rules in June 1971. Our change point estimate of August 1968, based on the data alone, also happens to be the very same month when public drunkenness was decriminalised in Washington D.C.

THESE ANALYSES USE autoregressive time series models, one to the left and another to the right of the unknown change point. Our methods point to August 1968 as a likely change point, and also that the standard deviation nearly doubled then. Importantly, such statements come along with assessments of how certain we can be, as summarised in the confidence curves in the figure. What is more certain than the level of uncertainty graphed there is that such subtle and half-visible change points would be very hard to find, quantify, and assess, without the appropriate statistical methodology.
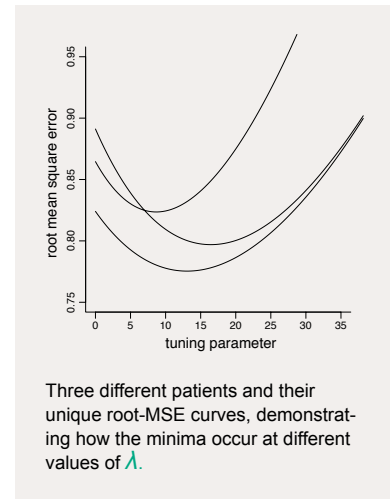
Kristoffer Hellton:

# It's Getting Personal!
# Personalised Regression Models

## PERSONALISED MEDICINE

**IS** becoming an essential part of modern medicine. It aims to use an individual's genetic information to tailor drug therapies or preventive care, thus taking into account individual heterogeneity. Within this framework, a patient's genes, proteins, and environment are utilised to prevent, diagnose, and treat disease. For cancer, for instance, personalised medicine uses information regarding a patient's tumour to plan treatment regimes, or make a prognosis. The Norwegian Cancer Genomics Consortium has been founded to establish nation-wide use of individual patient genetics to guide cancer treatment.

**SUPPOSE WE HAVE** observed $n$ patients with a complication $y_i$, e.g. increase in weight, and a vector of ten thousand genetic variables, $x_i$, and assume the outcome to follow a linear regression model
$$y_i = x_i^t \beta + \varepsilon_i,$$
with the regression coefficients, $\beta$, and independent noise with a certain standard deviation $\sigma$. As the high dimension requires regularisation, we estimate the regression coefficients via so-called ridge regression, which means
$$\hat{\beta}(\lambda) = (X^t X + \lambda I)^{-1} X^t Y,$$
involving a positive tuning parameter $\lambda$.

**IMAGINE NOW THAT** a new patient enters the doctor's office. We wish to predict the outcome variable for his or her specific covariate vector, $x_o$, as best as possible. Let the prediction for the new patient be our focus parameter, $\mu_o = x_o^t \beta$. When the regression coefficients are estimated by ridge regression, the mean squared error (MSE) of the estimate
$$\hat{\mu}_o = x_o^t \hat{\beta}(\lambda),$$
the prediction error, will be a function of the tuning parameter $\lambda$, and for each specific vector of covariates, $x_o$, the MSE curve will have a different minimum and a different minimand. In other words, for given $x_o$ there is an optimal $\lambda(x_o)$ which minimises the MSE, which again depends on $\beta$ and $\sigma$; this is illustrated in the figure. If these MSE curves can be estimated separately, for each $x_o$, we can lower the expected prediction error of each single individual. We have achieved this via pilot estimates of $\beta$ and $\sigma$ in the MSE expressions, following a two-stage procedure, and we term the resulting procedure focused ridge regression: the fridge (Hellton & Hjort, 2018). All other current fine-tuning approaches, from cross-validation to maximum marginalised likelihood, will only select one single tuning parameter value for all future use. Our fridge procedure will adaptively modify the selected tuning parameter to be as optimal as possible for the current $x_o$ in question, i.e. for the new patient entering the doctor's office. By utilising parametric bootstrapping, we can extend the proposed focused ridge procedure to more general settings, to obtain e.g. a focused logistic ridge regression.



Three different patients and their unique root-MSE curves, demonstrating how the minima occur at different values of $\lambda$.

**FOR ALL APPLICATIONS** within the field of personalised medicine, it is key to minimise the prediction error for a specific individual, rather than just the averaged error. Here, individual predictions can determine decisions with severe consequences: if a significant increase in a complication risk is predicted, this could trigger a surveillance response, or if a treatment is predicted to have a high success probability, it can be initiated despite possible adverse side effects. Hence, our goal is to develop statistical machinery minimising the prediction error for each patient, rather than the average prediction error for all patients.

**WE HOPE THAT** our methods will contribute to the development of personalised medicine and further showcase the fruitful relationship between statistics and modern medicine.
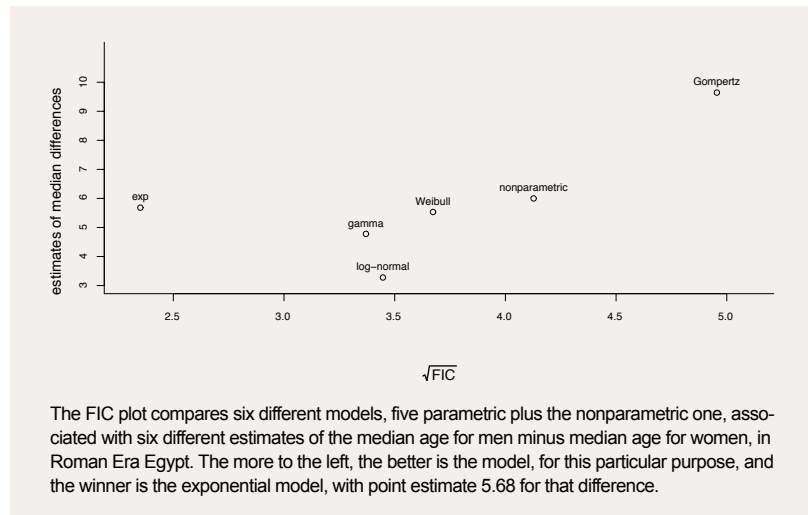
Nils Lid Hjort:

# The Focused Information Criterion

TO ANALYSE DATA, to reach clear conclusions, to form good predictions, etc., statisticians need models. Such statistical models give precise descriptions of how data behave, regarding both signal and noise, or structure and deviations, phrased in the mathematical language of probability theory. Models range from the simple (the number of times you'll see 1, 2, 3, 4, 5, 6 if you roll your die 1000 times), to the relatively straightforward (linear regression, with the perhaps ten covariates $x_1$, ... , $x_{10}$ that have been measured and taken care of in connection with a study to understand an outcome $y$), to the very complex (a hierarchical model with three layers and a hundred nodes at each, and where some of the mechanisms are understood and others not at all).

IN THE BEST of cases, there is enough basic understanding of the physics and mechanisms underlying the data that a single good enough statistical model can be put up, perhaps followed up with a goodness-of-fit test verification. In most applications, however, particularly if the data are complex, there will be many competing candidate models (which of the ten covariates $x_j$ ought to be included, and with which extra interactions?; which of the nodes should be part of a final hierarchical structure?). To handle such issues statisticians need an arsenal of model selection methods, followed perhaps with tools for forming data-driven weighted averages of estimates or predictions coming out of the best-looking models.



The FIC plot compares six different models, five parametric plus the nonparametric one, associated with six different estimates of the median age for men minus median age for women, in Roman Era Egypt. The more to the left, the better is the model, for this particular purpose, and the winner is the exponential model, with point estimate 5.68 for that difference.

THERE ARE INDEED several different types of model selection methods, for sorting through different candidate models, in different situations. Among the more well-known methods are the AIC (the Akaike Information Criterion) and the BIC (the Bayesian Information Criterion), which in different fashions balance overall-fit with overall-complexity.

THE FIC (THE Focused Information Criterion), developed by G. Claeskens and N.L. Hjort and later extended in several new directions and for new purposes by the FocuStat group, works in a different fashion. It takes specifically on board the notion that some questions are more important than others. It starts by (1) formalising what is most important with the final analysis, in the form of a context driven focus parameter, and then (2) assessing and ranking the precision of all candidate estimates for this focus parameter. Hammering out good FIC procedures depends on the classes of models worked with as well as aspects of the focus parameter.

SOMETIMES ONE MODEL might be best for some purposes, while another model could be better for other aims; similarly, one health quality prediction scheme might work well for men above 65, but another underlying model could be better for women between 50 and 60, etc. The FIC machinery assists in such modelling choices.

THE FIC PLOT here serves as a simple illustration, using data on life-lengths from Roman Era Egypt, the first century B.C., for 82 men and 59 women. We fitted six different models to the data, and can for each of these estimate quantities of interest, along with measures of uncertainty. Different focused questions lead to different FIC plots and potentially to different rankings of the candidate models.

Vinnie Ko:

# Multivariate Modelling with Copulae

**PROBABILITY DISTRIBUTIONS ARE** without a doubt at the heart of statistics. A probability distribution is a mathematical function that provides the probabilities of occurrences of different events, or outcomes (e.g. the probability of getting 6 from throwing a dice). When the probability distribution is only concerned with a single variable, it's called univariate (e.g. the probability of precipitation at a certain level $a$ in city A). When the probability distribution concerns multiple events of interest, or multiple variables, it's called multivariate (e.g. the probability that there is precipitation at a certain level $a$ in city A and at another level $b$ in city B). Most of the well-known multivariate distributions require that each of its univariate components has the same type of distribution. This is often an unrealistic requirement in practice. For example, the probability distribution for precipitation in Oslo can be very different from that of Bergen, while they nevertheless have a joint multivariate probability distribution.

**A COPULA IS** a general statistical tool for modelling multivariate probability distributions. It has as a strong advantage that it allows its univariate components to have different parametric forms. The main idea behind it is to "cancel out" each univariate distribution by transforming them with their own inverse. These transformed versions are then connected with a copula to form a multivariate probability distribution. The fact



Copula density plot for daily precipitation data, in Lørenskog and Nannestad.
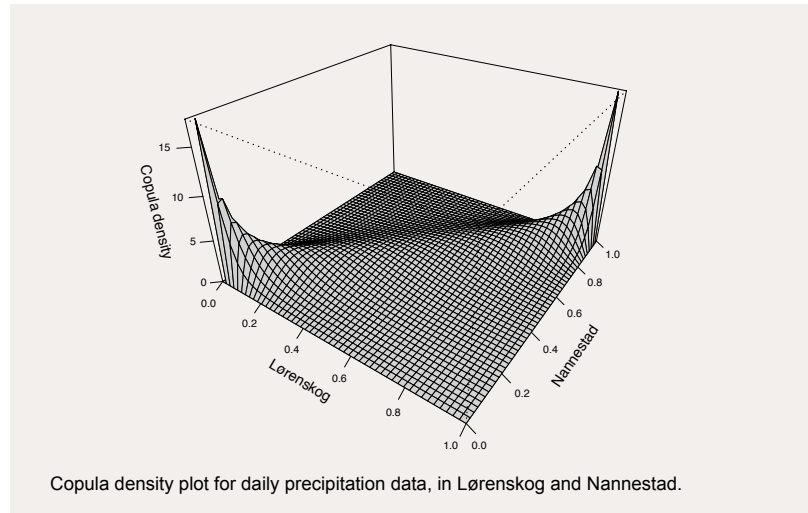
that its name "copula" comes from the same Latin word, meaning "link", or "tie", explains its nature well. Once univariate distributions and a copula are chosen, and the parameters are estimated, one has a model that can fully describe probabilistic relationships between events of interest. This works for any number of variables, e.g. as a modelling tool for analysing and predicting the precipitation level in five Norwegian cities.

**AS AN EXAMPLE,** we use a subset of the daily precipitation data from the Norwegian Meteorological Institute. We look at daily precipitation, measured in Lørenskog and Nannestad, between 1990 and 2006, only for the days when there was precipitation in both cities. The figure shows the so-called copula density plot from the fitted copula model. It basically shows that there is a positive dependence relationship in the precipitation between the two cities.

**WITH THIS MODEL,** one can for instance answer questions like "Given that there is precipitation above 10 mm in Nannestad, what is the probability that Lørenskog also has precipitation above 10 mm?", and "What is the chance that both Lørenskog and Nannestad will have more than 15 mm rain three days in a row?".

**AS PART OF** my FocuStat work, I have worked with different methods for estimating the parameters in such models, and also developed model selection criteria that help selecting the most appropriate copula for specific situations (see the Ko and Hjort papers in the References section).
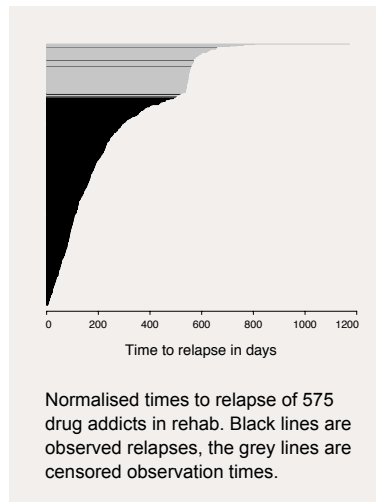
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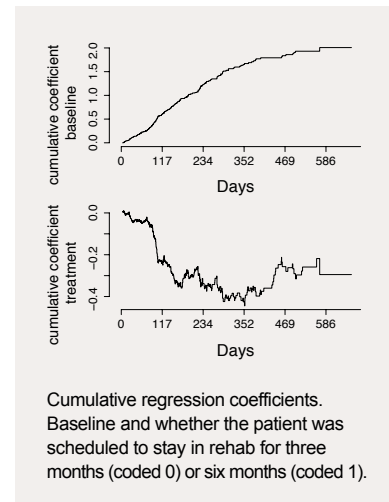Emil Stoltenberg:

# Relapse after Rehab

THE FIGURE DISPLAYS the time in days for 575 drug rehab patients from entering rehab to an eventual relapse. The black lines belong to those that suffered from a relapse, while the grey lines are those patients for which no relapse was observed. Standard survival analysis methods – which due to the time component and the censoring are often employed to analyse data sets such as this one – assume that all the patients in the sample will eventually relapse. In many applications this is an untenable assumption (luckily). In our example, rehab works for some patients, due to their genetic composition or the like, while others are doomed to a strenuous life of rehab-relapse-rehab-relapse ad infinitum. This raises several statistical questions. First, we would like to estimate the size of the two groups – the share of drug users for which rehab might work, and if data are available, what factors might contribute to an individual belonging to this group. Second, survival estimates such as that of the risk of relapsing must take into account that some drug users are cured, i.e. will never relapse; if not, they are likely to underestimate this risk.

A CLASS OF survival analysis models suited for such situations takes the population survival function, affecting both groups, as improper. That is, $S_{pop}(t)=P\{$alive at time $t\}$ tends to a number bigger than zero as time goes on. In our example, this is the share of cured patients for whom rehab actually works.



Normalised times to relapse of 575 drug addicts in rehab. Black lines are observed relapses, the grey lines are censored observation times.

THE MOST COMMON cure model takes the population survival function as $S_{pop}(t,x,z)=1-\pi(x)+\pi(x)S(t,z)$, where $\pi(x)$ is the probability of being susceptible to the event of interest, often modelled as the logistic function, with $x$ a vector of covariates, and $S(t,z)$ is the survival function of the susceptible individuals, that also may depend on covariates, typically via a Cox regression model. An alternative to the Cox model is Aalen's linear hazard rate regression model. It postulates that the i-th individual has a hazard rate function being a linear combination of covariates and regressor functions, say $\alpha_j(t)$.

IN SOME ONGOING work I extend Aalen's model for the hazard rate to the standard cure model above. This involves certain cumulative regression functions. The figure displays the baseline cumulative regression coefficient and the cumulative regression coefficient on the indicator of the planned



Cumulative regression coefficients. Baseline and whether the patient was scheduled to stay in rehab for three months (coded 0) or six months (coded 1).

length of stay in rehab, three months (coded 0) or six months (coded 1). The probability $\pi(x)$ was taken to be the logistic function with a covariate giving the so-called Beck score for depression when entering rehab. The estimates are rather bleak here; the most and the least depressed have estimated probabilities of 0.99 and 0.88 of relapsing, respectively. On a modestly brighter note, the estimated cumulative regression coefficient on the treatment indicator indicates that a longer stay in rehab has a protective effect, compared to a shorter stay.

THERE IS GOOD scope for extending and finessing methods pointed to here, using elements of the FocuStat machinery. One may construct parametric models for some of the $\alpha_j(t)$ functions; it would be useful to develop FIC schemes for selecting models best suited to the cure fraction; etc.

Sam-Erik Walker:

# Robust Estimation

**ALL STATISTICAL METHODS** use data. Most often these are all good and the statistical method yields satisfactory results. But sometimes the data might contain atypical or even incorrect values or entries, which should then ideally be spotted and removed before further analysis. Running an error-resilient approach with automatic screening and removal of atypical data without a proper analysis is not recommended, however. Even if a reasonably thorough check is carried out, one can easily be misled by deciding to down-play or ignore such data. A good example of this was in the slow discovery of the ozone hole over Antarctica in the mid-1980s (read Pukelsheim, 1990); for several years one saw the atypical but genuine data as errors.

**THERE ARE ALSO** various robust estimation and analysis methods which do well even without such initial data inspection work. These are methods specifically constructed to produce reasonably good results even in the presence of bad data, or, more generally, when the model used is not fully correct.

**ROBUST METHODS CAN** also be combined with so-called focused statistical approaches, one of the central themes of the FocuStat project, e.g. via appropriate finessing of the Focused Information Criterion, or FIC. It can be used to select among models based on a focus parameter, a certain parameter or function of parameters considered most important in a given statistical setting. The



FIC plots for the median for pre-1950 data (left) and post-1950 data (right) for the Pareto (green), inverse Pareto (orange), and inverse Burr (red) models, using the BHHJ estimator with a range of the tuning parameter a. The triangle identifies the maximum likelihood. The nonparametric estimates are shown as the blue points.
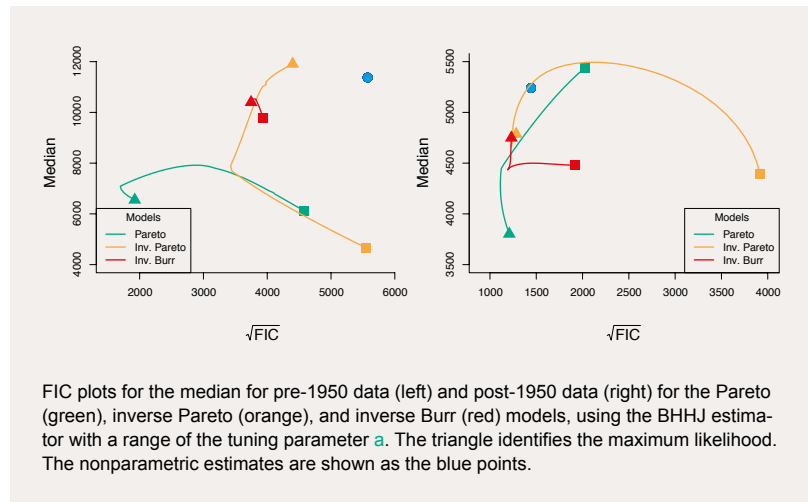
figure provides an illustration of this, relating to the estimation of the median number of battle deaths before and after 1950 based on the Correlates of War database (Cunen, Hjort, Nygård, 2019, Walker, Hjort, 2019), which contains the number of battlefield deaths for the 95 biggest interstate wars, from 1823 to the present.

**FOR THIS ILLUSTRATION** we take the median as the focus parameter, and FIC plots are shown involving four models (Pareto, inverse Pareto, inverse Burr, and the nonparametric), where the parameters of these models are estimated using a certain BHHJ estimator (Basu, Harris, Hjort, Jones, 1998), with its robustness vs. efficiency trade-off parameter $a \geq 0$. Here $a=0$ corresponds to the non-robust maximum likelihood estimator, and increasing $a$ implies more robustness.

**THE LEFT AND** right plots are

based on pre-1950 and post-1950 war data. In each plot, a FIC curve is given for each of the three parametric models, describing a relationship between the accuracy of the median estimates, via the root FIC score on the x-axis, and the resulting estimate of the median on the y-axis. Each FIC curve is plotted for a relevant range of $a$. The best combination of model and robust estimator is obtained by the point on a FIC curve lying most to the left. For the pre- and post-1950 data this is obtained for the Pareto model, with certain best balance parameters, and with best estimated median values of 7091 and 4272 battle deaths, respectively. We learn that robust use of a parametric model leads to the best median estimates.

**THE FIC METHODS** of Walker and Hjort (2019) used here represent an extension of those developed in Jullum and Hjort (2017, 2018), from maximum likelihood to classes of robust estimators.
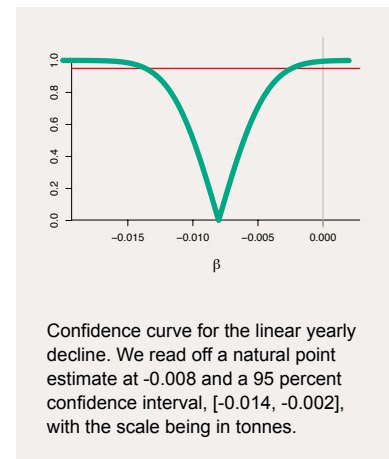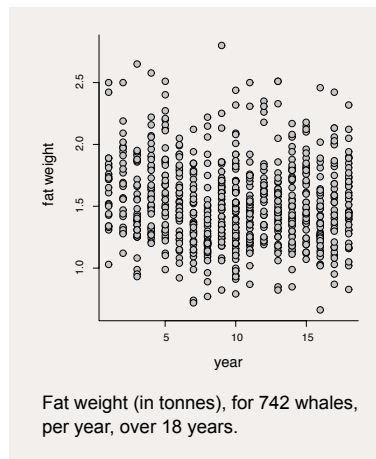
# Statistical Stories

Our project has had significant methodological components, resulting in general analysis machineries for different purposes of statistical inference. We've had a fair share of application stories, though.

These have involved wars, whales, angels, armed conflicts, medical statistics, speedskating, Game of Thrones, the world's first novel, the longest time series ever from fisheries science (with the Hjort index), the cooling of newborns after oxygen deprived births, air pollution, vocabulary sizes for toddlers, Ngrams for text analysis, why Americans chose to elect Mr Trump, French grammar, macro-economy, boy-girl analysis, and many more. Here we offer brief one-page statistical stories from our desks.

Céline Cunen:

# Are the Antarctic Minke Whales Becoming Thinner?



Fat weight (in tonnes), for 742 whales, per year, over 18 years.



Confidence curve for the linear yearly decline. We read off a natural point estimate at -0.008 and a 95 percent confidence interval, [-0.014, -0.002], with the scale being in tonnes.

THIS INNOCUOUS AND straight-forward-sounding question has been at the centre of a decade-long debate in the Scientific Committee of the International Whaling Commission (IWC). Set against a backdrop of political controversies, the debate itself concerned biological, and primarily, statistical issues. These issues led to the involvement of some members of the FocuStat team.

THE POLITICAL ASPECTS of the debate arise from controversies surrounding Japanese Scientific whaling. The data involved here originate from such whaling, the Japanese Whale Research Programme under Special Permit in the Antarctic (JARPA). The controversies and discussions in the IWC are certainly interesting, but outside the scope of this small note. They have been treated in some length in our blog post Whales, Politics, and Statisticans. Here we will focus on the statistical analyses and the results.

BIOLOGISTS ARE INTERESTED in the fat-reserves of Antarctic Minke whales because large-scale changes in such quantities could herald deeper transformations in the ecosystem, related to changes in krill production, the abundance of other whale species, or climate change. These potential explanations are fascinating, but first, one has to establish whether there is any change in fat-reserves at all, and estimate the magnitude of that change. Through our contact and collaborator Lars Walløe, we had access to measurements of body condition on hundreds of Antarctic Minke whales in a period of 18 years (from 1987/88 to 2004/05). One of the body condition measurements is the fat weight of each whale, which we display in the figure above.

THE FIGURE DOES not give the impression of a clear decline in fat weight. But wait! The different whales in the dataset are not directly comparable to each other; some are male, other female, they are caught in different periods of the year, and at different latitudes. In order to correctly address the question of decline in fat weight, a statistical model needs to be built. The model is constructed by considering the various factors which contribute to the observed fat weight of each whale. Here we used several candidate models from the class of linear mixed effects models, involving a list of several explanatory variables (both fixed and random, in particular the year-to-year variation), along with interactions. The focus of our investigations is the overall yearly decline in fat weight, related to the parameters of our candidate models. We have extended the FIC machinery to this class of models, thus helping us finding the best model for this particular question.

OUR RESULTS WERE presented in the form of a confidence curve for the yearly decline in fat weight. The curve indicates an effect which is *negative* and *significant*. The magnitude of the point-estimates corresponds to the average whale experiencing a loss of about 80 kg of fat over ten years. A typical whale has between one and two tonnes of fat, but bear in mind that the fat-reserves are vital for the whales' reproductive success and survival in the winter (when the whales typically do not feed). We concluded that the Antarctic Minke whales had indeed suffered a loss of fat-reserves from 1987/88 to 2004/05, and after several days of heated debate, our conclusions were essentially accepted by the Scientific Committee of the IWC.

Gudmund Hermansen:

# The Dramas of Escalation



The number of battle deaths in the Colombia conflict. Solid line: armed conflict, with the state (Colombia) one of the actors; dashed line: two non-governmental actors; dotted line: one-sided violence (by the state, rebel, or terrorist group).
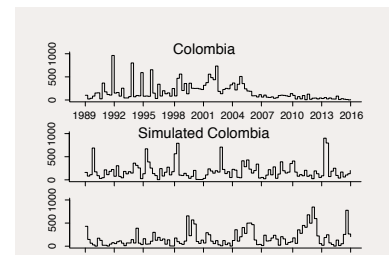


The sad Colombian truth (top panel), followed by two simulations from the estimated statistical violence process model (two lover panels). In detail, the plots display the quarterly number of battle deaths in Colombia, from 1989 to 2016.

WARS ARE BEING fought in Syria, Iraq, Afghanistan, Somalia, with these and other ongoing wars and violent conflicts producing death tolls not seen since the Cold War. Existing instruments, from diplomacy to power politics, have largely proven inadequate for stopping or reducing the violence in such conflicts. Furthermore, policy makers as well as the research community lack proper understanding and good answers to several important questions. Why do some civil wars remain low-intensity conflicts, whereas others escalate, to claim the lives of hundreds of thousands? And why do some non-violent protest movements escalate into bloody civil wars, whereas others remain peaceful? There are no clear answers to the key questions of how, why, and when do low-intensity conflicts experience escalation in violence, as in the case of Colombia between the government and FARC, which saw a ten-fold increase in battle deaths from 1993 to 2005, after thirty years of relatively low-intensity conflict.

CONFLICT RESEARCHERS HAVE only a rudimentary understanding of the determinants and dynamics of conflict escalation. A deeper understanding of conflict escalation is critical both for advancing the study of political and social order, and for preventing the human suffering that escalation inflicts.

WE MIGHT ALL have an intuitive notion of what escalation or conflict escalation means, but this key concept is elusive and difficult to define and model. We take observed escalation to mean a substantial change in the lethality, geographic scope, number of participating actors, targets of violence, repertoires or technologies of violence utilised, or aims of the actors involved in conflict; cf. what is graphed in the figure. More refined definitions are required, however, for a more systematic understanding; policy makers rely on insights from high-quality research studies.

THE CONCEPTUAL AND statistical definition of escalation should depend on which questions we aim to answer. In ongoing work with Håvard Nygård (PRIO), we have pursued several paths, for building meaningful statistical models for the violence processes. These should capture the essentials, in terms of inputs, reflecting different scenarios or decisions, and simulations from an estimated model should look like "the real thing".One might build models for the probabilities of passing from one level of conflict to
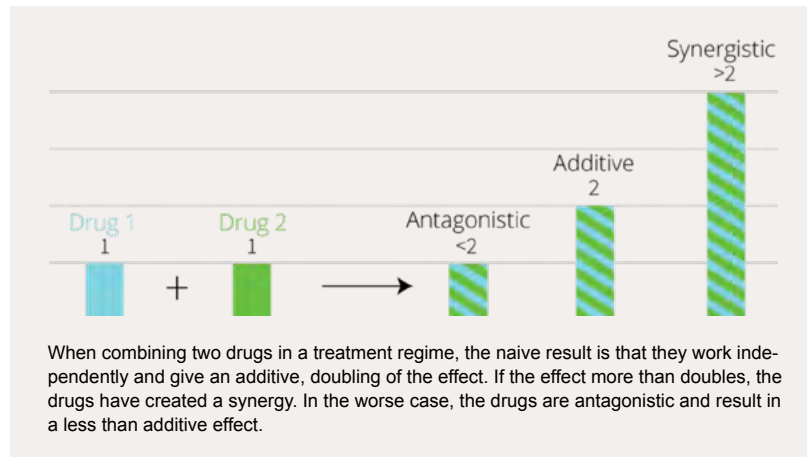
a higher level. A fruitful approach is in terms of an underlying conflict intensity, which might evolve dynamically over time, and depending on relevant covariates (these include economy, natural resources, type of government, number of fighting neighbours, etc.). The number of fatalities are then Poisson- or mixed Poisson-type outcomes, stemming from the underlying conflict intensity function. Our escalation models take on board the possibilities for rapid changes, and relative constancies for periods of time. That our models work is reflected in simulations, with spikes and plateaus, see the figure. Such may also be used to predict future levels of conflict under different scenarios.

AN IMPORTANT ASPECT of our modelling work is that a certain increase in violence level should not too automatically be interpreted as a genuine escalation (in contrast to what is seen in other quantitative analyses of these conflicts). Among the aims, for ongoing and planned work, also for the Stability and Change project with Hjort and Nygård, is to move beyond the current understanding of escalation, in order to obtain the level of knowledge required to bring about change.

Kristoffer Hellton:

# I Have a Dream! The Drug Synergy DREAM Challenge



When combining two drugs in a treatment regime, the naive result is that they work independently and give an additive, doubling of the effect. If the effect more than doubles, the drugs have created a synergy. In the worse case, the drugs are antagonistic and result in a less than additive effect.

IN THE AUTUMN of 2015, I joined a Big Insight team entering the AstraZeneca-Sanger DREAM Challenge, a community effort to develop new approaches of predicting beneficial drug combinations. Targeted therapies and personalised treatments are the most promising assets for treating cancer. However, in many patients, a tumour can be innate or have acquired a resistance to given therapies, which can render treatments ineffective. To increase therapeutic options, cancer researchers have been actively investigating new drug combinations. When combining different treatments in new ways, the most desirable property is drug synergy – an amplified response over and beyond an additive effect. Drug synergism has the potential to increase anti-tumour potency without increasing toxicity, but it is very complex to study due to the enormous number of potential combinations.

FOR THE DREAM challenge, AstraZeneca released around 11 000 experimentally tested drug combinations for 118 drugs (with over 7000 combinations) in 85 different cancer cell lines. Moreover, the Sanger Institute made measurements of genomic data, including gene expression, muta-

tions copy-number alterations, and methylation data, accessible to all participants. The main challenge was to develop statistical methodologies which would control the large combinatorial space of potential combinations and at the same borrow information across both drugs, cell lines and the range of genetic data. The available data set was partitioned such that 2/3 could be used for training the models and the remaining 1/3 needed to be predicted as correctly as possible in the challenge finale.
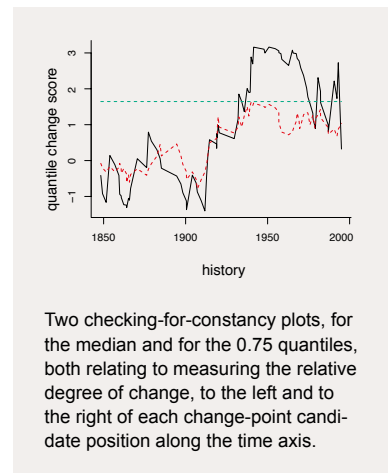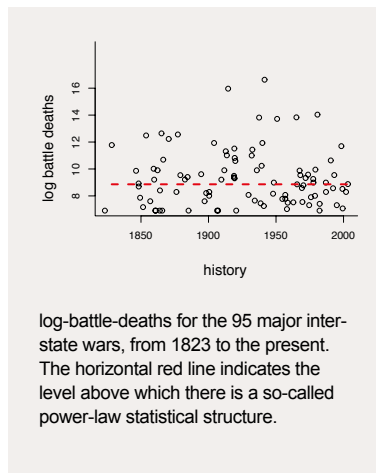
THE OSLO TEAM, organised by Arnoldo Frigessi and Manuela Zucknick at the Department of Biostatistics, formed a joined team, minor insight, together with the MRC Biostatistics Unit at Cambridge, led by Lorenz Wernish and Sylvia Richardson. To best exploit a final model ensemble step, we followed different but complementary modelling strategies. The Cambridge team utilised kernel radial basis regression with a ridge penalty, based on constructing similarity matrices between all observations with all data pooled together. The Oslo team had separate approaches for the drug characteristics and the genetic data. First, a gradient boosting model with non-linear trees was

used to predict the monotherapeutic effect of each drug, based on the drugs chemical and molecular characteristics. Then a multiresponse ridge regression approach was used to predict synergy based on all the different available genetic data. Unknown synergy values in the test set were filled in following the iterative Healy-Westmacott procedure. Both models were further fine-tuned by cross-validation. In the end, all models, also the separate Cambridge and Oslo contributions, were averaged to produce an ensemble prediction model with weights based on cross-validated prediction errors.

WORKING IN A fast paced team with a high energy spirit was both immensely fun and scientifically rewarding. The Cambridge participants even visited Oslo for a few highly enjoyable days of intense interdisciplinary teamwork. Admittedly, we lost to various other teams, but gained vital insights from our modelling efforts. In retrospect, we have concluded that our proposed models were too rigid and at the same time did not incorporate enough genetic information. The community effort of advancing drug synergy prediction is currently being published as a consortium paper in the journal *Nature*.

Nils Lid Hjort:

# War, Peace, and Statisticians



log-battle-deaths for the 95 major inter-state wars, from 1823 to the present. The horizontal red line indicates the level above which there is a so-called power-law statistical structure.



Two checking-for-constancy plots, for the median and for the 0.75 quantiles, both relating to measuring the relative degree of change, to the left and to the right of each change-point candidate position along the time axis.

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EACH WAR IS dramatic and horrible and warrants a hundred history books and a thousand songs of sorrow. But it also provides one more data point, along with relevant covariates, to the collection of Tolstoyan war-and-peace databases, and statisticians may study the evolution of alleged decreasing violence levels over time. One of the bigger questions is both deceptively simple and quite controversial: is the world becoming more peaceful over time, or not?

IN HIS FAMOUS book The Better Angels of Our Nature, Steven Pinker has a long chapter on The long peace, and argues, along several paths and dimensions, that the world is become steadily more peaceful. There are fierce voices against such a verdict, however. In the Cunen, Hjort, Nygård article Statistical Sightings of Better Angels (2019), we report on several relevant statistical models and analyses, pertaining to data which we in this simplified discussion denote $(t_i, x_i, z_i)$, for the 95 major interstate wars from 1823 to the present. Here $t_i$ is the onset time, $z_i$ is the battle death count, and $x_i$ contains relevant covariate information; we have e.g. utilised a certain democracy score, to form such a covariate for the warring nations, registred before the outbreak of war.

SEVERAL MAJOR QUESTIONS can be posed and analysed just with the $(t_i, z_i)$ data, cf. the first figure, which shows $(x_i, \log z_i)$ over time. In some of our analyses we demonstrate that the world of wars has *not* remained constant over time; there *is* a statistically significant change of levels, for the better. The second figure is a case in point, where we show, via specialised models and methods that we have developed, that any change in the median of the distribution is too smal to register properly, but that there is a significant change if we focus on e.g. the upper quartiles (the 0.75 quantile). Also, the estimated regime-shift, or historical change-point, is at 1950, the time of the Korean War. The red curve relates to comparing medians, and the flucuations around zero are not significant. The black curve relates to comparing 0.75 quantiles, where the plot signals (a) that there is a significant change, and (b) that the likely year for that change is in 1950, the Korean war.

AS THIS SHORT glimpse into the modelling and analyses already indicates, what we are able to find depends on how questions are posed and finessed; it is too much to hope for a very simple "the world changed for the better in 1950, period". Indeed, when we shift our attention to the bigger wars, separately, those at so-called power-law behaviour level, our methods point to 1967, the time of Vietnam and Flower Power.

SO WE HAVE contributed to the statistical verification of The long peace. But what are its contributing factors, and what political aspects might be at stake, in order to avoid future escalation? This is where the covariates come in, the sequence of $x_i$ (along with delicate discussions of precisely what to put into these scores, how to measure democracy level, etc.). In addition to securing high-quality data of relevance, one needs more advanced statistical models and methods. Our paper delves into such questions too. We find that having a high democracy score is associated with a clear decrease in battlefield fatalities. The broader hope is to understand at a deeper level, both statistically and in terms of political processes and actions, what leads to stability, or to escalation, or to war. Our models may also be used to predict aspects of future conflicts.

Vinnie Ko:

# 234 focustatske meldinger



VINNIE KO
MET HARTELIJKE
GROENTE NEDERLANDS DOOR KOREAANSE OGEN

PODIUM

Vinnie Ko's 2016 book delivers a multitude of both humorous and serious reports on attempting to understand the Dutch, the people and the language, seen through Korean eyes. With a modicum of trepidation we look forward to his book on how to understand Norway (if possible), her language and her statisticians, seen through Korean and Dutch eyes.

I 2016 FLYTTET jeg fra Nederland til Norge for å begynne med min doktorgrad på UiO. Jeg var den heldige, med et stort privilegium, ikke bare fordi jeg fikk lov til å begynne et nytt eventyr i et nytt land, men jeg hadde også total frihet til å velge hvem som helst som veileder for min PhD, siden min finansiering kom fra Matematisk institutt selv.

ETTER AT JEG hadde snakket med «alle de voksne som muligvis kunne være veileder» innenfor statistikk-seksjonen, valgte jeg Nils Lid Hjort, hovedsakelig fordi han har kule og brede interesser, og forståelse for hva jeg gjør utenfor statistikk. Etter vårt første møte, foreslo han at jeg ble med på hans FocuStat prosjekt. Et par dager senere fikk jeg min første focustatske melding, adressert til alle syv deltakere av gruppen:
Dato: 24.08.2016
Emne: focustatsk melding nr. 246: ny møtetid. *«Hei (der denne kollektive hilseinterjeksjon nå også omfatter Vinnie), [...] Vinnie, kan du maile til meg og Celine, med opplysning om \*which hours during the week you're busy with lectures or other matters\*? After the required kollisjonsmatrise exercise we'll then find a new time* window for our weekly meetings – so find your calendars.»

I DET ØYEBLIKKET var jeg nettopp ferdig med mitt seksukers norskkurs, hvor vi hadde øvet med ting som «Jeg liker meg her i byen» og «Jeg vil gjerne ha en pølse i lompe». Jeg tenkte: sånn bruker ekte nordmenn sitt språk! Og skrev ned 'hilseinterjeksjon' og 'kollisjonsmatrise' i ordlisten min.

FRA MØTE NR. 2 bestemte Nils seg for å kjøre alt på norsk igjen, akkurat som før jeg kom i gruppen. I de første månedene kunne jeg ikke følge alt hva de seks norske sa. Da var det de focustatske meldingene som reddet meg. Før møtene sendte Nils oss melding om kommende møte og saker. Og etter møtene skrev han en e-post om alt vi hadde gjennomgått, og med tanker om det neste.

«RUNDE RUNDT BORDET» hadde vi stadig: *«Kristoffer forteller fra sin eksotiske reise; Sam-Erik om de siste syv metre frem mot completion for Two; Gudmund om diverse og Data Science kick-off; Nils om siste fire gode ideer innenfor changepointeri, og om Kongen igår; Celine har knapt med tid, med to foredrag og tre timers Bayes hver fredag ...»* (nr. 450, 05.09.2018)

DETTE VAR IKKE begrenset til faglige punkter, men handlet om alt som hadde skjedd med oss i FocuStat: *«Vinnie har kjøpt smågodt til prisen kr 30 pr kg.»* (nr. 363, 24.10.2017) Og noen ganger handlet det om nødvendig tvangsarbeid: *«Folkens, ta heisen opp til 7. etasje, til kl 18:29:59. Så tar vi noen tvangsfotografier der, hvorpå vi kanskje også unner oss å spasere til 'Focus på torvet', fire minutter unna, for å tvangs- smile enda litt mer.»* (nr. 332, 14.06.2017) Eller om konsekvenser: *«Hvis vi ikke får godkjent vår statusrapport, legges prosjektet øyeblikkelig ned, og dere settes på gaten (men ikke jeg, da).»* (nr. 254, 25.09.2016)
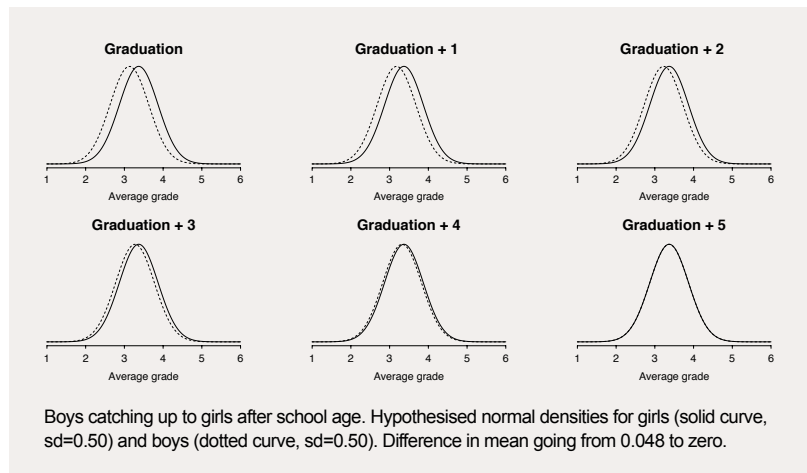
I BEGYNNELSEN MÅTTE jeg søke ord og uttrykk i ordnett.no hver halvsetning for å dechiffrere ordene hans. Men takket være de foreløpig 234 focustatske meldingene, ble jeg herre over norsk, med svært høyt stigningstall i læringskurven.

SNART NÅR FOCUSTAT sin ende, og vi skal levere inn en sluttrap- port. For denne gangen er jeg ikke redd for å settes på gaten. Hvis vi skriver ut alle 478 focustatske meldinger og stifter dem sammen, har vi allerede en fin sluttrapport!

Emil Stoltenberg:

# Boys, Girls, and Gauss



**Graduation**     **Graduation + 1**     **Graduation + 2**

**Graduation + 3**     **Graduation + 4**     **Graduation + 5**

Boys catching up to girls after school age. Hypothesised normal densities for girls (solid curve, sd=0.50) and boys (dotted curve, sd=0.50). Difference in mean going from 0.048 to zero.

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IN THINKING FAST and Slow, Daniel Kahneman writes about statistical intuition. A person, he writes, can possess statistical intuition albeit being devoid of mathematical skill. I agree. The following hypothesis, which is not mine, but belongs to my mother, is a good example of how statistical intuition can guide thinking about a social phenomenon.

THE SHARE OF men with a fragile connection to the labour force, who do not find a partner, nor have any children constitute a growing minority in many western countries. As with all social phenomena, this might be due to a plethora of reasons. One reason, nevertheless, seems to be that girls perform better in school than their male peers. And the reason why the girls outperform the boys might simply be that girls mature earlier than boys. Instead of searching for complicated societal explanations, my mother's statistical intuition was that the normal distribution should have something to tell us.

IN NORWAY IN 2017 the average grade (grades range from 1 to 6, with 6 being the best) in Videregående skole was 3.37 for girls and 3.13 for boys. Let's simplify. Suppose that in 2017 there were 1000 aspiring students finishing upper secondary

education in Norway, 500 girls and 500 boys, all dreaming of spending at least five years at the University of Oslo. The UiO only accepts 200 students, and only cares about the average grades of the applicants. Assume that the perfomance of the girls and the boys can be represented by independent draws from normal distributions with the same spread, but differing means. Set the standard deviation to 0.50 and the means to 3.37 for the girls and 3.13 for the boys; see upper left in the figure. So how many girls and how many boys will commence studies at the UiO after the summer? Among the 200 students accepted we can expect there to be 140 girls. This number, 70%, is close to the actual at the prestigious medicine and law programmes in Norway.

THERE IS A perceived social phenomenon for which our normal distribution toy example can provide insights: among students who do not finish upper secondary education, the dropout-boys seem to fare better later on in life than the dropout-girls. Again, we have two normal distributions with means 3.37 and 3.13 for girls and boys, and the same standard deviation 0.50. Assume now that the students with an average grade below 2.88 drop

out. Then 31% of the boys and 17% of the girls drop out (not too far from the actual figures). Clearly, one reason for "dropout-boys doing better than dropout-girls" might just be that they outnumber the girls, so just based on the numbers we'll hear more stories about the former dropout-boy now being his own employer (en gründer!), and we are led to think that dropping out is less serious for boys than for girls.

IT MIGHT ALSO be the case that dropping out of school has less serious long-term consequence for boys than for girls. Consider the normal densities in the figure. The five subsequent plots illustrate how boys might catch up with the girls as time proceeds – think of each plot being one year extra removed from graduation – while the girls, in our toy example, are fully mature at graduation. Under this scenario, about half of the boys who dropped out of school would not have done so five years later. The dropout-girls, on the other hand, would still have dropped out five years later. In this way, the delayed maturation of boys might explain why dropout-boys appear, or indeed are, more prone to succeeding in life than the girls who shared their fate as late teens.

Sam-Erik Walker:

# Ozone Decline over Europe
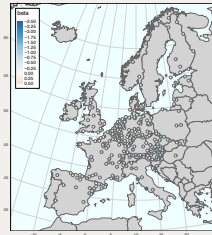


Estimated trend coefficients of summer season ozone from GAM modelling, for the 302 rural stations, for the period 2000 to 2010. Negative and positive trends are shown using blue and red colours, respectively. The unit is ppb/year.
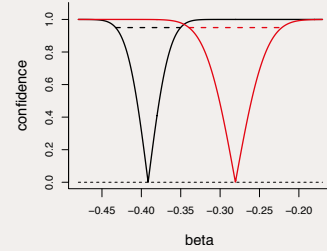


Confidence curves for the overall trend coefficient $\beta_0$ of the summer season ozone in Europe, at the rural (black, left) and suburban stations (red, right), for the period 2000 to 2010 (left plot). The unit is again in ppb/year.

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HAS THERE BEEN an overall decline in surface ozone in Europe, over the past decades? The answer turns out to be yes, as we report on here. The data consist of maximum 8-hour running daily average concentrations of ozone, for the summer seasons (1 May to 31 Aug), at 302 rural and 210 suburban stations, across Europe.

AT EACH STATION, a specially designed Generalised Additive Model has been fitted to the ozone data, using corresponding meteorological data at each station as smooth explanatory variables. The meteorological data consist of modelled daily values of air temperature, relative humidity, wind speed, solar short-wave radiation and atmospheric boundary layer height. In addition, a day of season variable (relative to 1 May each year) and a linear long-term trend describing the potential change in ozone over time were introduced as additional explanatory variables. Thus, at each station, the model is
$$O_3(t) = \alpha + \beta t + \sum_j s_j(x_j(t)) + \varepsilon(t),$$
relating the daily ozone values $O_3(t)$ to smooth functions $s_j(x_j(t))$ of the meteorological and day of season variables $x_j(t)$ and to the crucial linear trend in ozone $\alpha + \beta t$, where $t$ represents time in years,

from 2000; finally, $\varepsilon(t)$ represents the error term, taken normally distributed with mean zero. The linear trend may be interpreted as a meteorology adjusted trend at each station, mainly influenced by trends in various precursors to ozone from emissions of nitrogen oxides (NOx) and volatile organic compounds (VOCs) from traffic and industry.

OUR FOCUS HERE is on the trend over time, specifically the $\beta$ parameter. This trend parameter varies across Europe. Analysing the model above yields an estimate $\hat{\beta}_i$ for station $i$, along with a standard deviation $\sigma_i$. As seen from the figure, a negative (downward) trend is found at most of the rural stations, but not all.

THE GRANDER QUESTION is whether the overall European ozone trend has been negative, for the 2000 to 2010 decade. We answer this by modelling the individual $\beta_i$ as coming from an appropriate background distribution, a normal $N(\beta_o, \tau^2)$. Using modern meta-analysis, via confidence distributions, as developed in Schweder and Hjort (2016, Ch. 13), we can estimate both the overall trend parameter $\beta_o$ and the spread parameter $\tau$, along with confidence curves.

AS SEEN HERE, the confidence curve to the left points to an overall average decline in summer season ozone in rural Europe of -0.391 ppb per year, or -3.91 ppb per decade, with [-4.33, -3.50] as a 95 percent confidence interval for the latter. For the suburban stations, the overall estimate is -0.281 ppb per year, or -2.81 per decade, with 95 percent interval [-3.40,-2.22]. This represents a small but significant decline in the ozone levels corresponding to around 0.8 percent per year, or 8 percent per decade, relative to the typical mean level of summer ozone at the rural stations, for the period 2000 to 2010. The decline for the suburban stations is about 6 percent per decade. Since the individual GAM based trends at the stations were meteorologically adjusted, this decline is probably mostly due to a reduction in emissions of precursors to ozone such as NOx and VOCs from traffic and industry. This is good news, since surface ozone represents a potential hazard for both health and agricultural crops.

ELSEWHERE WE WILL also report on the degree of variation, for this negative ozone trend parameter, across Europe, also for the suburban data.

# Workshops and the VVV Conference

We have organised theme-based three-day international workshops in 2015, 2016, 2017, with about 25 participants for each, and a somewhat bigger four-day international summing-up conference in 2018, with about 45 scholars taking part.

Planning and organising these have been tasking, challenging, time-consuming, but also fun, fruitful, and inspiring. They have involved and led to collaborative work and fostered new ideas. The three three-day workshops were held in Teknologihuset, close to Bislett, inspiring also Bislett-related cover photos for our programme booklets.

Gruppenbild mit Dame, from one of our workshops at Teknologihuset.

Programmes:



Inference With Confidence
May 2015



FICology
May 2016
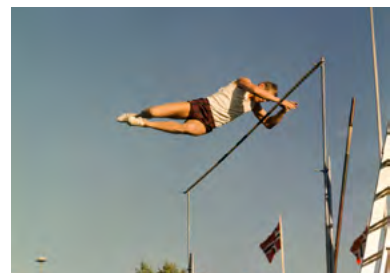


Building Bridges at Bislett
May 2017



Vårens Vakreste Variabler
May 2018

May 2015:

# Inference With Confidence

Confidence Distributions and Related Themes

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› The Holy Grail
› Posteriors without priors
› Optimal inference,
  with confidence

**3** days  **23** participants  **16** talks  **7** countries

IN MAY 2015 we did Inference With Confidence, on Confidence Distributions and Related Themes.

SPEAKERS WERE C. CUNEN, A. Frigessi, S. Grønneberg, J. Hannig, K.H. Hellton, G.H. Hermansen, N.L. Hjort, B.H. Lindqvist, R. Liu, T. Schweder, D. Sun, G. Taraldsen, P. Veronese, S.-E. Walker, M.-g. Xie. Themes were partly of a theoretical nature, developing confidence distributions for new purposes, but also included real-world application stories. The Excursion With Confidence was at Ekebergparken, with a forestful of sculptures.

OUR WORKSHOP EFFORTS led also to a Special Issue of the Journal of Statistical Planning and Inference, with N.L. Hjort and T. Schweder as guest editors for the occasion (assisted crucially also by C. Cunen's efforts). This actually involved almost two years of editorial processing, with papers to be finished and then contributed, reviewed, sent back for improvements, etc., before the final versions appeared in the journal (Vol. 195, May 2018, 174 pages). Schweder and Hjort's Cambridge University Press 2016 book Confidence, Likelihood, Probability also benefitted from the workshop.



Gruppenbild mit Dame, from one of our workshops at Teknologihuset.

May 2016:

# FICology

Focused Information
Criteria and Related Themes

› **Focused inference**
› **Model averaging**
› **Wars and whales**

**3** days

**25** participants

**19** talks

**8** countries



Inspiring & inspired participants, at one of our workshops at Teknologihuset, Bislett: Charkhi, Argyrou, Pircalebelu, Grünwald, Claeskens, Hegre, van Ommen, Ghosh, Gandy, Hobæk Haff, J. Vestby, Walker, Nygård, Grønneberg, Jullum, Schweder, Hjort, Stoltenberg, Østbye, Hermansen, Moss, Van Keilegom, Cunen, Hellton. L. Walløe and M. Zolghadr also took part.

IN MAY 2016 we did FICology, on Focused Information Criteria and Related Themes. The Focused Information Criterion was first invented and developed by G. Claeskens and N.L. Hjort, in two JASA papers 2003, followed by discussion contributions, etc., leading also up to their Cambridge University Press 2008 book Model Selection and Model Averaging. The FocuStat group has contributed to various extensions and generalisations of the FIC, including in particular efforts of C. Cunen, G.H. Hermansen, Hjort, M. Jullum, V. Ko, S.-E. Walker, and these endeavours, along with those of several others, were presented at the FICology workshop.

SPEAKERS WERE A. CHARKHI, G. Claeskens, C. Cunen, A. Gandy, P. Grünwald, S. Grønneberg, H. Hegre, K.H. Hellton, G.H. Hermansen, N.L. Hjort, I. Hobæk Haff, M. Jullum, V. Ko, T. van Ommen, E. Pircalabelu, I. Van Keilegom, S.-E. Walker, L. Walløe, P. Østbye. In addition to many methodological issues, related to constructing new FIC versions for new purposes, and examining performance, two important applied talks were given by H. Hegre, on forecasting incidence of internal armed conflicts, and L. Walløe, on the decline in energy storage in minke whales.

OUR CULTURAL EXCURSION this time was at the Akershus Fortress, and Schützenglene (with Nils) gave us Byrd, Byrd, Byrd.

May 2017:

# Building Bridges at Bislett

Bridging Parametrics and Nonparametrics

| **3** | **24** | **20** | **6** |
|:---:|:---:|:---:|:---:|
| days | participants | talks | countries |

› Bridging two worlds

› Local parametric modelling of nonparametrics

› Parametric models with nonparametric envelopes

THEN IN MAY 2017 we did Building Bridges at Bislett, Bridging Parametrics and Nonparametrics. Topics worked with included the many ways of estimating a density or a regression function by combining parametric models and nonparametric schemes, such as methods generalising or further combining Hjort-Glad or Hjort-Jones approaches, minimum divergence, etc.

THOSE GIVING TALKS were R. de Bin, C. Cunen, T. Egeland, I. Glad, K.H. Hellton, G.H. Hermansen, N.L. Hjort, M. Jullum, V. Ko, J. Moss, S. Petrone, I. Prünster, C. Rohrbeck, E.Aa. Stoltenberg, B. Støve, D. Tjøstheim, S.-E. Walker. Cunen investigated ways of combining parametric and nonparametric confidence distributions; Hjort discussed the Hybrid Likelihood approach involving parametric and empirical likelihoods; Jullum and Ko illustrated novel ways of using FIC for comparing parametrics with nonparametrics. Also, Petrone and Prünster delved into Bayesian nonparametrics, with the fruitful idea of building nonparametric envelopes around parametric models. Egeland, Rohrbeck, Stoltenberg used their methodology to go into substantial applications.

OUR EXCURSION BRIDGED us to a guided tour of the Astronomical Observatory building from 1833, the oldest building of the University of Oslo, where the congregation was also properly morley'd by Schütz-englene (with Nils).

May 2018:

# Vårens Vakreste Variabler

Summing-up Conference

- - - - - - - - - - - - - - - - - - -

| **4** | **44** | **23** | **9** |
|---|---|---|---|
| days | participants | talks | countries |

› **Summing up**
› **Mozart and TTT**
› **Cool strong applications**

WITH THREE SUCCESSFUL theme-based three-day workshops at Teknologihuset Bislett behind us, we went for a somewhat Bigger Occasion in May 2018, with a four-day broader Vårens Vakreste Variabler summing-up conference, with about 45 participants at the Ingeniørenes hus. Hjort used the occasion and the Birkeland-Eyde lecture hall to tentatively press upon us all the Four Rules of Statistics Communication.

SPEAKERS WERE R. DE BIN, Ø. Borgan, G. Claeskens, C. Cunen, I. Eckley, H. Gjessing, J. Hannig, K.H. Hellton, G.H. Hermansen, N.L. Hjort, I. Hobæk Haff, A. Hubin, M. Jullum, V. Ko, P. Mykland, H. Nygård, S. Richardson (half of the UiO's honorary doctorates in the field of statistics), L.T.S. Rønneberg, T. Schweder, E.Aa. Stoltenberg, A. Whitmore. Day four of the conference was set aside for Cool Strong Application Stories, featuring long lives (Borgan), personalised model- and simulation-based medicine for cancer treatments (Frigessi), wars (Nygård), and whales (Cunen). Two journalists eagerly followed the proceedings.

IN THE WORDS of one seasoned participant, which we dare to include here, *"I have been in academic life since the mid-1960s and attended many conferences, workshops and the like. I have never … and, I repeat, never … had such a fulfilling experience. FocuStat offered a unique opportunity to learn from others. You assembled a very engaging and stimulating group. This has been a week of great memories, including the surprise and delightful musical interludes. […] Abundant future research and practical advances will surely flow from this conference."*

THESE MUSICAL INTERLUDES gave us both Mozart's G major KV 423 and a fiery Friday morning dixieland-ish TTT (for trommer, tuba, trompet).
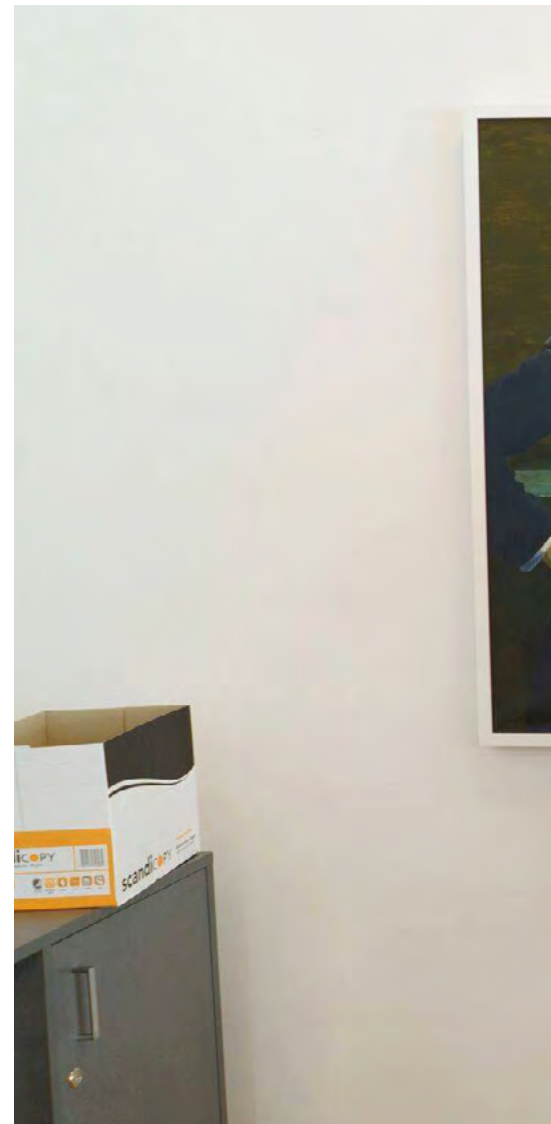


Professor, Hjort, gründer, Cunen.
Let's avoid nederlag for historiefaget.



Taksdal, Kronberger, Mozart.

VVV dinner: expressing gratitude.



Arnoldo Frigessi about new statistical approaches for personalised cancer therapies.

# The FocuStat Research Kitchens

A research kitchen is a term invented by the Steering Group of the European Science Foundation funded project Highly Structured Stochastic Systems (1995–2002). The point is to provide the minimum of funding and organisational necessities to allow a small group of scholars, perhaps less than a dozen, to meet for a few days, to discuss and interact (and to have meals together), without the formalities of conference talks, etc.

We have had as many as five such smaller-scale, theme-based, three-day FocuStat Research Kitchens. They have been fun, fruitful, productive, inspiring, just as kitchen work ought to be. Our list of Kitchens is as follows.

In the kitchen spirit of things, an impromptu discussion, along with a real-time construction of a HIC (a Hyvärinen Information Criterion), with Hjort's hand, during the FocuStat Kitchen 2015.
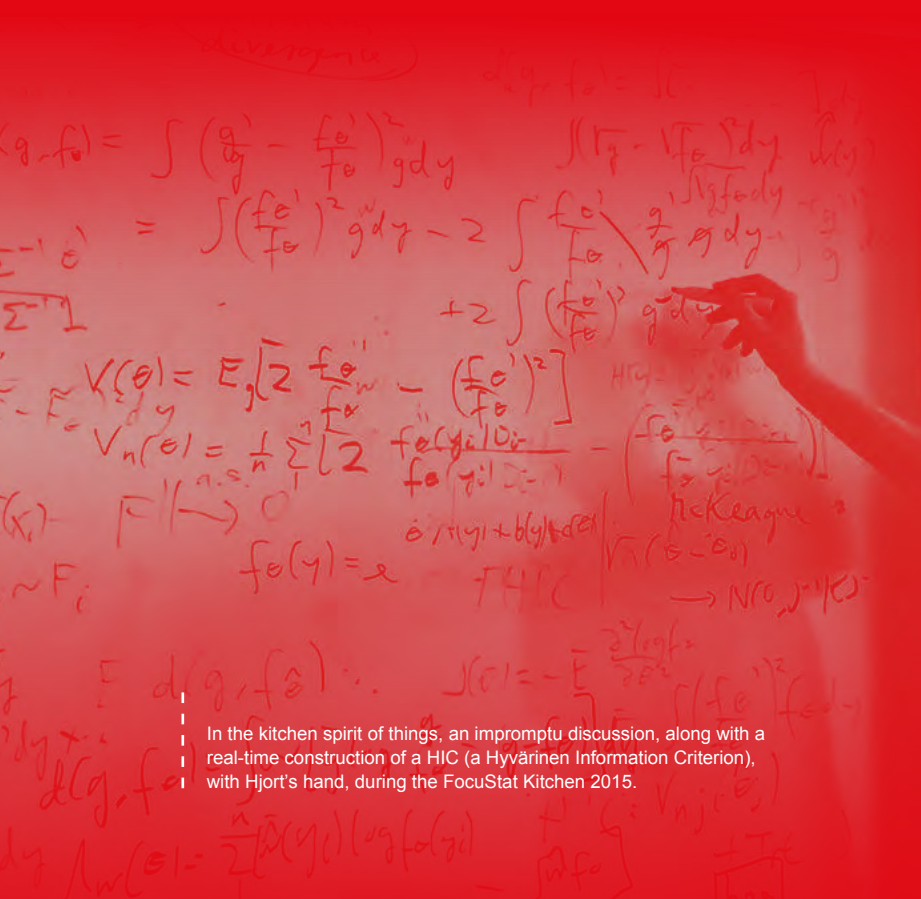
## Empirical Likelihood

- - - - - - - - - - - - - - - - - -

IN SEPTEMBER 2014 we had a small meeting on Empirical Likeli-hood, with I. McKeague and I. Van Keilegom, and some of the recently appointed FocuStat members. Hjort, McKeague, Van Keilegom have worked together on earlier projects (here's a note in the IMS Bulletin, 2009, on how their work on extending the scope on the empir-ical likelihood came about). This kitchen helped push ideas concern-ing how to meld ordinary parametric likelihoods and the nonparametric empirical likelihood, later on leading to another joint paper. We also dis-cussed other research ideas.

## Minimum Divergence and Scoring Rules

- - - - - - - - - - - - - - - - - -

IN SEPTEMBER 2015 we had a kitchen on Minimum Divergence and Scoring Rules, partly intended to help push S.-E. Walker's PhD project. Our kitchen guests were F. Krüger (Heidelberg), M. Musio (Cagliari), T. Thorarinsdottir (Norwegian Computing Centre). We picked up theory for Hyvärinen scores along the way, and worked out certain generalisations and even a HIC (a Hyvärinen-based Information Criterion). Some of the minimum disparity methods we dis-cussed are intricate, causing Hjort to give a presentation on *Minimum Dispair, Maximum Despair*.

# L^\eta, Многая лета

- - - - - - - - - - - - - - - - - - - - - - -

IN OCTOBER 2016 we did L^\eta, Многая лета, concerned with the many ways in which "the likelihood raised to a power parameter" turns up, in robustification, in Bayesian learning, in regularised estimation, etc. Guests included T. Broderick (MIT), P. Grünwald (Amsterdam), J. Miller (Harvard), P. Müller (Austin, Texas), A Ghosh, and locals I. Glad, P. Mykland.
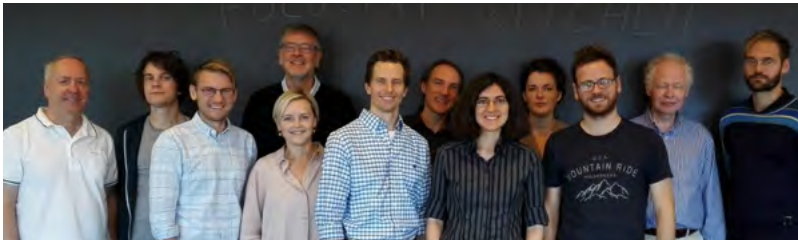


A happy group, learning more about the many ways in which we may raise the likelihood to a power parameter: S.-E. Walker, G.H. Hermansen, K.H. Hellton, I.K. Glad, N.L. Hjort, J. Miller, P. Grünwald, T. Broderick, C. Cunen, R. de Bin, P. Mykland, E.Aa. Stoltenberg. J. Argyrou, A. Ghost, P. Müller also took part.

# From Processes to Models

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THEN IN NOVEMBER 2017 we did From Processes to Models, on a list of themes related to the concept of building process models "behind the data", in various connections and applications. The general idea is that when such background models are biologically or context-wise plausible, they lead to better models for the data themselves, compared to off-the-shelf type methods for these. All FocuStat members were on board, and guests were R. de Bin, S. Engebregtsen, C. Heinrich, B. Lindqvist, J. Moss, R. Parviero, T. Thorarinsdottir, M. Tveten.

# Combo Kitchen on Combining Diverse Information Sources

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FINALLY WE HAD our Combo Kitchen in November 2018, concerned with methods for combining statistical information across very diverse sources. In addition to the core group, and several Oslo locals, we had I. Carmichael (Chapel Hill), D. De Angelis and A. Presanis (Biostatistics Unit, Cambridge), M. van Nee and M. van der Viel (VU, Amsterdam). Themes included the II-CC-FF methods of Cunen and Hjort, evidence synthesis, empirical Bayes, Bayesian co-data learning in ridge models, and drug interaction prediction, and applications to government directed vaccination policies in the UK.



- - - - -

The Combo Kitchen!, November 2018.



The Combo Kitchen crew, eagerly learning to combine information and knowledge sources. The music stand was used for the Telemann duet. From left: V. Vitelli, C. Cunen, A. Presanis, I. Helland, R. Parviero, J.F. Schenkel, D. De Angelis, N.L. Hjort, M. Zucknick, M. v Nee, I. Carmichael, M. vd Wiel, K.H. Hellton.

# VIPs, Guests, Collaborators, Networking

In addition to being active on the workshop and conference fronts, we have also had a fair stream of guests, for shorter and longer time, for exchanges of ideas, and for serious collaborative work. Some of us have established long-term working relationships with colleagues, from Oslo and abroad.



Hard at work, during the Mykland Week, November 2016: Hjort, Hermansen, Stoltenberg, Hellton, Cunen, Mykland, Walker. Ko took part for some of the days. There are traces of cleverly invented weighted log-likelihoods on the blackboard.

DURING THE PROJECT we've organised Important Evaluation Weeks, featuring first Alan Gelfand, Duke University (November 2015), and then Per Mykland, University of Chicago (November 2016), as our one-week evaluators. This meant presenting parts of our projects to these Very Important Professors, theme after theme, result after result, application after applications, where the VIPs then gave us important feedback, from constructive criticism to a bit of praise. It takes time and forces, for all concerned, but is a very fruitful way to learn, including learning what is still remaining for a piece of work to be good enough, or to become very good. Also important have been our friendly but constructive local critics, professors Arnoldo Frigessi and Ingrid Glad, who have followed our progresses and processes and offered advice and wisdom.

PROFESSOR EMERITUS WITH UiO, Tore Schweder, deserves special mention in these paragraphs, since he has been a positive and constructive friend of the full group, and for his long-term productive working relationship with Hjort. They finally managed to finish their magnum opus, the *Confidence, Likelihood, Probability* (500 pages with the Cambridge University Press, 2016), and were guest editors for the Special Issue on Confidence



The Schweder and Hjort *Confidence, Likelihood, Probability* 500-page book is out; here at the ISBA in Sardegna, June 2016, with our Cambridge University Press agent Diana Gilloly.

Distributions and Related Themes, with *Journal of Statistical Planning and Inference*. This Special Issue came about partly as a result of the successful FocuStat workshop Inference With Confidence.

IN THE LIVES of academics and research one rarely clings to One Plan Only, as other matters tend to cross our desks, or turn up as questions to pursue during workshops or via personal contacts, whether by inci- or accident or not. Two important strands of Unplanned Work for us, in particular for C. Cunen and N.L. Hjort, have turned out to involve *whales* and *wars*. These have escalated into Serious Research and the time-consuming business of writing scientific papers, giving presentations at conferences, and even being interviewed by media. Also G.H. Hermansen is involved with the wars.

THESE ENDEAVOURS HAVE come about via personal contacts with Lars Walløe (senior scientist in multiple areas, chemistry, physiology, medicine, statistics, advisor to the government, former President of Academica Europeae, etc.) and Håvard Nygård (senior researcher and research director with Peace Research Institute of Oslo).

WALLØE HAS BEEN involved with the Scientific Committee work of the International Whaling Commission, for a number of years, and one specific research theme has raised considerable interest and controversy: Have the Antarctic minke whales become thinner, over the past few decades, or not? And what is the role of statistical model selection here? Initial discussions with Hjort, and then Cunen, led to research work and new analyses, in the form of journal papers to come, lectures and seminars, interviews by some media, and also, crucially,

to us taking active part in the Scientific Committee meeting of the IWC, in Bled, Slovenia, May 2017. Here Cunen presented several analyses, and had to stand firm in a stream of countering views from Australian researchers, almost in a courtroom situation. Notably, Hjort has also worked with Walløe and his colleague Marianne Thoresen regarding a partly controversial journal article on the cooling of newborns after oxygen deprivation during birth; see Hjort's blog post for the issues under debate.



Walløe, Cunen, Hjort at the Scientific Committee meeting with the International Whaling Commission, Bled, Slovenia, 2017, complete with pink whales on our name tags, apparently.



Nygård, Hjort, with master student J.K. Haug (jointly supervised by Hjort and Nygård), going into war and peace research. Hjort reads Война и мир, the others read Pinker's Better Angels of Our Nature.

PRIO ORGANISES A series of Oslo Lectures on Peace and Conflict, and in January 2018 Hjort was invited to be a panel discussant after a lecture by Aaron Clauset, where the claim was made that the world of wars has remained essentially stationary over the past 200 years. Hjort dared to disagree with this, however, finding significant traces of evidence in the benevolent direction of "the world is slightly more peaceful now". In the Towards a More Peaceful World [insert `!' or `?' here] blog post, written up after this event, arguments are also presented pointing to 1967, the time

of the Vietnam War and Flower Power, as a likely change-point, with the battle-death distribution for great wars changing for the better then. Steven Pinker's quick twitter reponse, "Sophisticated new analysis of the stats of war by Nils Lid Hjort affirms a decline over time, but finds the sharpest in 1967, not 1945", spurred further attention and interest in these statistical models and analyses, and has led to the Statistical Sightings of Better Angels paper with Cunen, Hjort, Nygård. Also, G.H. Hermansen is pursuing joint work with Nygård, on the escalation of conflicts. There will be more joint work, with some of us and some from PRIO, including efforts to develop and finesse statistical methods for change-points. What are the mechanism securing stability, and which underlying parameters and processes might lead to conflict?

WE WISH TO convey that our crew have maintained a group spirit throughout our project, also when it comes to new ideas coming in and floating around. When the whales surfaced in front of us and the wars popped up, those of us who pursued the themes actively also benefitted from weekly discussion meetings and insights emanating from these.

IN ADDITION TO Schweder, Walløe, Nygård, other scholars are on our collective interactive map of active collaboration. Hellton has worked with and continues to work with Claudio Heinrich, Lasse Giil, Thordis Thorarinsdottir, Jo Røislien; Hermansen with Steffen Grønneberg at BI and as mentioned with Nygård; Hjort also with Gerda Claeskens, Ingrid Glad, Ingrid Hobæk Haff, Ingrid Van Keilegom; Ko with Fabian Gieske; Stoltenberg with Per Mykland and his co-supervisor Sven Ove Samuelsen; and Walker with colleagues at NILU.

# FocuStat Excursions

We have been unusually busy travelling to various workshops and conferences, along with other research visits, though not all of us all of the time.

We decided early on, however, that we for each year should single out one conference, where we all tried to go (and to give lots of talks, and otherwise being active). In addition there has been a list of cultural excursions on our agenda.
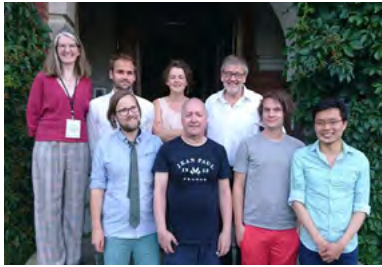
In Rio, checking out the latest in professorial papelaria paraphernalia: Cunen, Hermansen, Walker, Hjort, Hellton.

## Workshops and Conferences

- - - - - - - - - - - - - - - - - -

IN AUGUST 2015 we went to exotic Rio de Janeiro, for the 60th International Statistical Institute Conference. Hjort gave an invited talk on combining information sources via confidence distributions, Cunen talked about Poisson models for two-by-two tables, Hellton about high-dimensional principal components, Hermansen on FIC for time series, and Walker on probabilistic forecasting of air pollution. Incidentally, before Rio most of us also went to the Norwegian Statistical Meeting in Solstrand, giving a significant percentage of the presentations. In June 2016 we took eager and high-visibly part in the NordStat 2016, the Nordic Meeting on Mathematical Statistics, in København. Cunen and Hellton won Best Poster Awards, and Hjort had an invited session, featuring also the hybrid likelihood.

AFTER RIO AND København we upped the ante in June 2017 by going to the Norwegian Statistical Meeting at Fredrikstad, again giving lots o' talks. And in June 2018 we again went to the NordStat, where this particular Nordic Meeting on Mathematical Statistics took place in Tartu, Estonia. Cunen had the strenuous privilege of organising an invited session, on confidence distributions, and the others gave talks in different sessions.

AMONG THE MANY other workshops and conferences we've taken part in, for the years 2015-2018, and where several of us have presented invited lectures, we single out the following.

Various core and associated FocuStat members in historical Tartu, June 2018: K.F. Frøslie, E.Aa. Stoltenberg, C. Cunen, N.L. Hjort (back row); J. Moss, S.-E. Walker, G.H. Hermansen, V. Ko (front row).

IN 2013, N.L. HJORT won the Sverdrup Prize and gave a talk at the prize award occasion; he was also invited to give the Corcoran Memorial Talk at the Department of Statistics, University of Oxford. In 2014, Hjort gave invited talks at the 2nd World Conference on Nonparametric Statistics, Cadiz, and at the 35th International Society for Clinical Biostatistics, Wien. Then in 2015, Hjort gave such invited talks at the 60th International Statistical Institute World Congress in Rio de Janeiro, and E.Aa. Stoltenberg represented Norwegian statistics at the 19th European Young Statisticians Meeting in Prag. Invited talks occasions for Hjort in 2016 included the Fusion Learning and BFF Conference at Rutgers, the Joint Statistical Meeting in Chicago, and the Post-Selection Workshop at Leuven; also, he was invited session organiser at the International Society for Bayesian Analysis in Sardegna. K.H. Hellton was an invited speaker at an Oberwolfach Workshop on high-dimensional data.

2017 MARKS THE year where C. Cunen in particular starts getting a high number of invitations to give talks, take part in panels, speak to young students, etc. She gave in particular an invited talk at the 61st International Statistical Institute World Conference in Marrakech, and gave several presentations at the Scientific Committee Meeting of the International Whaling Commission, in Bled. Hjort gave six hours of invited lecturing at the annual Geilo Winter School for Applied Mathematics. He had other invited talks, including at the BFF in Harvard, the Bayesian Nonparametrics Conference in Paris, and the Joint Statistical Meeting in Baltimore. Cunen, Hjort, Stoltenberg were invited speakers at the Sylvia Richardson Honoris Causa workshop in Oslo. Then in 2018 both Cunen and Hjort appeared on certain panels, at peace-and-conflict arrangements at the Peace Research Institute of Oslo, and Cunen was invited to organise a three-lecture session at the NordStat Meeting in Tartu.

Excursions:

# Cultural Excursions

THE FOCUSTAT CREW have also taken part in various cultural excursions (with and without gentle pushing). We've sang four-part specially made songs for several of our end-of-semester meetings; once we composed ten verses of FocuStat themes with an arrangement of Revolusjonens røst, for four voices and two celli; we've been to the University Symfoniorkester to hear Brahms (with Cunen on the cello); played pieces for two celli and piano; we've watched Emil Stoltenberg fly through the air (with Nordberg Basket winning against Persbråten); we had a skiing day all the way to Kobberhaugen; and we've read Houellebecq's Soumission for a book discussion evening. Once upon a time we even went to the cinema, to watch "Focus" (which we didn't quite understand).

THERE HAS ALSO been various musical pre-, inter- and postludes at our kitchens, workshops, conferences, and meetings. The Schützenglene (with Nils, and led by Tor Tveite) have been singing, apparently specialising in the 1590ies repertoire (but with different composers and languages, from workshop to workshop); Nora Taksdal and Janina Kronberger have played the KV 423; Are Rosseland, Marius Gjersø, Steffen Granly cleverly interrupted the VVV proceedings by their TTT (trommer, trompet, tuba); and in the Combo Kitchen we had Frederik Vogelfänger Aakre (with Nils joining him to play a Telemann



Blindern Stunt- og Geriljakor singing after Cunen's PhD disputation, about to tallis the audience.

duet). When the Erling Sverdrups Plass was offically opened, at the 8th floor in the Abel Building, in September 2015, our cellists Cunen and Hellton played Kummer.

IT WAS WITHIN the crew spirit of things, then, that Nils hired Blindern Stunt- og Geriljakor, led by Tor Tveite, to sing about wars, whales, and angels, after Cunen's PhD disputation (where her dissertation themes included, indeed, wars, whales, and angels).

# The FocuStat Blog

The FocuStat crew have actively used The FocuStat Blog as an outlet for telling Statistical Stories, related to matters that cross our desks or otherwise catch our attention.

The traditional outlets for conveying research, for academic and applied statisticians, remain those of journal articles and talks at seminars and conferences, whereas many stories deserve to be told in a crisper fashion and to a broader audience, regarding both the methods themselves and their applications.

THE FOCUSTAT BLOG has proven to be a success story, in terms of numbers of visitors (some of our blog posts have been read by thousands), and by inspiring further attention and discussion (some have led to interviews and media attention). It often takes more than half a year to hammer out a solid article for a top journal, even after the main ideas have been understood and worked out, and another half year to have it accepted and published. But when N.L. Hjort used one long weekend to write up a blog story on whether the world has become more peaceful or not, based on war battle death statistics from 1823 to the present, it was read by thousands after a few weeks (partly thanks to Steven Pinker, who tweeted praise for the analysis). Similarly, C. Cunen's blog post comparing Game of Thrones with the Wars of the Roses managed to attract broad international attention.

OTHER BLOG HITS have been those concerning sports – statistical stories related to speedskating, cross-country skiing, football, handball, have been picked up by many. After one such blog post, Hjort took part in Abels Tårn, explaining to the people why the Olympic 1000 m sprinters should skate twice. Also, Norway won more medals than any other nation in the 2018 Olympics, but what does a proper binomial counting process analysis say?

THE FOCUSTAT BLOG shall go on, with new Statistical Stories, also after the formal end of the FocuStat project. As of January 2019, a partial listing of the Blog Posts is as follows.

**Towards a More Peaceful World [Insert '!' or '?' here]** is one of many Blog Posts which have caught international attention.

Céline Cunen (left) is becoming world famous, apparently. Her FocuStat Blog Post Mortality and Nobility in the Wars of the Roses and Game of Thrones (2015) has attracted world-wide attention. She has given several talks and interviews about the relevant statistical, historical, science-fictional themes, and different types of media, in at least a dozen different languages, have discussed her work.

dec
2014

N.L. Hjort:
Norway-Spain 28-25: How exciting was it?

Poisson models are used to compute and display Real Time Real Excitement Plots™, the probabilities of team A winning, or team B winning, or having a draw, in real time, as the match proceeds.

sep
2015

K. Hellton:
Hvor stemmes det hva i hovedstaden?

Local differences and variation in Oslo people's voting patterns are examined.

oct
2015

C. Cunen:
Mortality and Nobility in the Wars of the Roses and Game of Thrones

Analyses of survival time, including the probability of having a violent death, for different strata, are carried out, and then compared, for two comparable universes.

oct
2015

N.L. Hjort:
Conspiracy Probability Calculus for Norwegian Footballers

When the Norwegian Football Association carried out a so-called random drawing for the 8 matches in the round-of-16-teams, towards the end of the Cup Tournament, the result was met with disbelief. Was a conspiracy under way?

oct
2015

M. Jullum, D.R. Baños, N.L. Hjort:
To liv: kvinnene i Lillestrøm som ble født på samme dag og døde på samme dag

Two girls are born on the 14th of December, 1912, and 101 years and 11 months later they die at the same day, in Lillestrøm. How can we give reasonable answers to questions like "how unlikely is this"?

dec
2016

K. Hellton:
The bonus roll and the Christmas spirit

A popular "Christmas roll" changes its winning chances dramatically

once an innocent looking rule is changed.

mar
2016

N.L. Hjort:
Recruitment Dynamics and Stock Variability: The Johan Hjort Symposium, some personal reflections

This post was written up by the invitation of the Hjort Centre of Marine Biology, giving the writer another chance to think through the life and work of his great-grandfather.

jan
2017

C. Cunen, N.L. Hjort:
New statistical methods shed light on medieval literary mystery (January 2017).

*Tirant lo Blanc* is arguably the world's first novel, written in Catalan in the 1460ies. When did Author Two take over for Author One?

→

*jan* 2017

N.L. Hjort:
But some are more equal than others.

Almost miraculously, Allan Dahl Johansson and Odin By Farstad ended up having exactly the same point-sum after four distances of speedskating in the Norwegian Junior Championships. Just how phenomenally rare is this?

*feb* 2017

N.L. Hjort:
The semifinals factor for skiing fast in the finals

Petter Northug won a bronze in the ski sprint event at the 2010 Vancouver Olympics – but why not the gold?

*feb* 2017

N.L. Hjort:
Ut på tur: NordStat 2016, København juni 2016

A report is given from the FocuStat excursion to NordStat 2016, where we took eager part, and won two prizes.

*jul* 2017

E.Aa. Stoltenberg:
Frekventisme, Bayes og likelihoodprinsippet

This is a philosophically inspired essay on the two-or-more schools of statistics.

*nov* 2017

C. Cunen, G.H. Hermansen, E.Aa. Stoltenberg:
Bokmelding: Confidence, Likelihood, Probability (Schweder og Hjort, CUP 2016)

Three eager readers give their account of the CLP book.

*nov* 2017

T. Schweder:
Bayesian Analysis: Always and Everywhere?

As our guest writer, Schweder spells out why even a Nobel Prize winner may be wrong, through unforeseen consequences of a certain type of a Bayesian prior. The confidence distribution approach works rather better.

*des* 2017

N.L. Hjort:
Cooling of Newborns and the Difference Between 0.244 and 0.278

Cooling of neonates can save small lives, after traumatic births with oxygen deprivation. This depends crucially on the time window, however, and here a recent JAMA 2017 study is criticised.

*jan* 2018

C. Cunen, N.L. Hjort:
Whales, Politics, and Statisticians.

Just occasionally our research enters the hot soup of controversy and politics and international cricism, as here, where we presented our analyses for the slimming-or-not of the Antarctic Minke whales, for the Scientific Committee of the International Whaling Commission.

*jan* 2018

N.L. Hjort:
Towards a More Peaceful World [insert '!' or '?' here]

We analyse the horrible sequence of battle death counts, in all major interstate wars since 1823, and point to statistical evidence of better angels.

*feb* 2018

N.L. Hjort:
One Thousand is Unfair, Two Thousand is Fair

The 500 m and 1000 m events are the Formula One challenges of speedskating, and their the intricacies of inner and outer lanes matter, in an Olympically significant fashion. Medals may change necks, if a skater is given another start lane.

*feb* 2018

N.L. Hjort:
The Best Metal-Grabbing Games Ever

Norway had an astounding metal count, at the 2018 Olympics, but surely a binomial process approach to medal counting is more appropriate than mere counting when factoring in that fewer events and fewer nations took part in earlier Olympics.

*jul* 2018

N.L. Hjort:
Belgium Breaks a 48 Year Old Curse (Apparently).

The media claimed it was almost on a miracle level, when Belgium turned 0-2 against Japan to a 3-2 victory. But how improbable was this?

*aug* 2018

N.L. Hjort:
Overdispersed Children

The boy-to-girl ratio is not quite 50-50, and neither is the girl-probability constant across families, and perhaps not even inside families. It turns out children are both (slightly) overdispersed and (slightly) Markovian.

# Awards & Prizes

Somewhat rarely but then always jubilantly, prizes & awards are being bestowed upon FocuStat members. Here's our list.

K.H. Hellton and C. Cunen won the Best Poster Presentation Awards at the NordStat Conference, København, June 2016, here in front of Cunen's poster.

C. Cunen: Best Poster Presentation, NordStat 2016, København.

C. Cunen: The Titan Prize 2018, for science communication.

C. Cunen, representing Norway, European Young Meeting of Statisticians, Beograd, 2019.

K.H. Hellton: Best Poster Presentation, NordStat 2016, København.

G.H. Hermansen (with N. Foldnes and S. Grønneberg): The Cappelen Damm faglitterært forfatterstipend (NOK 100.000), for their book writing project, 2015. The resulting book Statistikk og dataanlyse: En moderne innføring was published in 2017.

N.L. Hjort: Sverdrup Prize, 2013. This prize is awarded every second year, by the Norwegian Statistical Association, to an eminent representative of statistics in Norway. Its first recipients have been Dag Tjøstheim (2009), Tore Schweder (2011), and now Hjort (2013). Later winners are Odd Aalen (2015) and Ørnulf Borgan (2017).

N.L. Hjort: giving the Corcoran Memorial Lecture, at the occasion of the 25th year of Department of Statistics, University of Oxford, 2013.

N.L. Hjort: elected member of the Kongelige Norske Videnskabers Selskab (the Royal Norwegian Society of Sciences and Letters), January 2017. He is also elected member of the Videnskaps-Akademiet (the Norwegian Academy of Science and Letters), since 1999.

M. Jullum: The Norwegian Computing Centre Prize, for best Master Thesis within mathematics and information sciences, at the University of Oslo (supervisor: N.L. Hjort), November 2013.

M. Jullum: Ahtlete of the Month, for the International Orienteering Association, August 2014.

E.Aa. Stoltenberg, representing Norway, European Meeting of Statisticians, Prag, 2015.

E.Aa. Stoltenberg: Fulbright stipend, for working at the Stevanovich Center for Financial Mathematics at the University of Chicago, August 2018 to June 2019.



C. Cunen won the Titan Prize for science communication 2018. Here she is flanked by Titan's main editor Wenche Willoch and Vice Dean Kristin Vinje wth the Faculty of Mathematical Sciences, University of Oslo.

# FocuStat in the Media

FocuStat projects and participants occasionally attract the attention of the media. Here's a partial list.

## 2014:

*jul* 2014 — Our PhD student Martin Jullum is World Champion in Pre-Orienteering, in Trentino, Italy.

*aug* 2014 — Our World Champion Martin Jullum is Athlete of the Month of the International Orienteering Federation.

*des* 2014 — General release occasion, with a bit of media attention, of the Ad Fontes Festskrift for Terje Kvam, where Nils Lid Hjort has contributed his Deilig er Jorden essay.

## 2015:

*apr* 2015 — Denne 27-åringens regnestykker skal gi bedre kreftbehandling, claims *Budstikka*, about Kristoffer Hellton.

*jun* 2015 — Martin Jullum wins the bronze in the Pre-Orienteering World Championship in Zagreb, Croatia.

*oct* 2015 — Matematikere på Blindern har regnet ut sannsynligheten for sammentreffet mellom Borghild og Khuu. «Hvis man sjekker en billion kvinner, vil man finne fem slike par», explains Martin Jullum and David Ruiz Baños, to *Aftenposten-TV*.

*oct* 2015 — *Aftenposten's A-Magasinet* has a special edition about "Two Lives", with the fascinating life stories of two women, born on the same day, who died on the same day, in Lillestrøm, 101 years later. They asked for help regarding the

simple-but-complicated question "how unlikely is this". Martin Jullum, David Ruiz Baños and Nils Lid Hjort are credited in the special edition for assessing and presenting different aspects of that question. This also led to the FocuStat Blog Post To liv: kvinnene i Lillestrøm som ble født på samme dag og døde på samme dag.

# 2016:

**may 2016** Gudmund Hermansen behind the success of the Oslo Data-Science Meetup, explains *Big Insight*.

**aug 2016** Martin Jullum grabs the silver in the Pre-Orienteering World Championship (after Martin Fredholm) in Strömstad, Sweden.

**aug 2016** Céline Cunen is featured in *Titan*: The death rate in Game of Thrones is realistic.

**sep 2016** Céline Cunen is featured in *Universitas*: The death rate in Game of Thrones is closer to real history than you think.

**oct 2016** «Bra påvist! Påvis mer!», writes selveste Natt og Dag, about Céline Cunen's work on the Wars of the Roses.

**nov 2016** Vinnie Ko has his splendid book Met Hartelijke Groente launched in the Netherlands.

**nov 2016** November 2016, and for a long row of later occasions: Vinnie Ko has so many interviews and rescensions and book signing occasions that he could easily have his own "in the media" list – and, inderdaad, he has; check his in de media here.

**nov 2016** Emil Aas Stoltenberg takes part in *Urix, NRK*, concerning the ins & outs of the US elections.

**nov 2016** Emil Aas Stoltenberg is in *Dax18, Dagsnytt Atten, NRK*, to explain US elections to the people; he returns the next day, also in *Dax18*, to explain more.

**dec 2016** UiO-forskere undersøker om Donald Trump er julenissen, reports *Titan*, again relying on the Centre of Apparent Excellence for Jule- og Julenisse-forskning, where N.L. Hjort seemingly is on board.

# 2017:

**jan 2017** Céline Cunen is featured in *Titan*: New statistical methods shed light on mediaeval literary mystery.

**apr 2017** Céline Cunen is giving an «åpen dag» University of Oslo lecture, also shown (and kept) on television, NRK Skole.

*aug* 2017 Arbeiderpartiet faller, men vinner: *Finansavisen* interviews Kristoffer Hellton, Anders Løland and Clara-Cecilie Günther.

*sep* 2017 Aber Ihre Untersuchung war nicht nur Spaß, Céline Cunen?, fragt *Technology Review*, in their interview, for readers in three countries: Game of Thrones ist historisch realistisch.

*sep* 2017 Ender med å velge det trygge: *Dagens næringsliv* interviews Kristoffer Hellton.

*nov* 2017 Jo da, miljøfartsgrensen virker. Article in *Aftenposten*, about air quality in the Oslo region, by Britt Ann Kåstad Høiskaar (NILU), Dag Tønnessen (NILU), Sam-Erik Walker (NILU and the FocuStat group).

*dec* 2017 The Centre of Excellence for Jule- and Julenisse-forskning, with Hjort among the alleged experts, is portrayed in *Titan*: Du kravlende, glitrende, krypende, kravlende ...

*dec* 2017 Another entry in *Titan*, with the same Centre of Excellence for Jule- and Julenisse-forskning: Har julenissen spist for meget rød fluesopp.

# 2018:

*jan* 2018 Céline Cunen and Nils Lid Hjort are portrayed in *Titan*: Mest sannsynlig at Den lange freden begynte under Vietnamkrigen.

*jan* 2018 Steven Pinker tweets admiration for Nils Lid Hjort's blog post Towards a More Peaceful World [Insert `!' or `?' here].

*jan* 2018 Nils Lid Hjort is a panel discussant for the PRIO event Oslo Lectures on Peace and Conflict.

*jan* 2018 January 2018: Nils Lid Hjort and Håvard Nygård are portrayed in *Titan*: Uvisst om Den lange freden er kommet for å bli.

*jan* 2018 Nils Lid Hjort, now qua literary analyst, apparently, makes it to the =Oslo.

*feb* 2018 Om å spise opp en rygg. Nils Lid Hjort on *NRK P2 radio*, the cultural channel (of course), 22-ii-2018.

*feb* 2018 Last ned statistikeren som endra OL (og vil gjøre det igjen). Podcast, from *Abels Tårn* (Vaffel og Vitenskap), 16-ii-2018; tv programme version aired on 20-ii-2018, *NRK2*. Nils Lid Hjort was starstrøkk some weeks earlier, when Pinker tweeted his admiration for



N.L. Hjort is properly starstruck when taking part in Abels Tårn (February 2018).

the War-and-Peace FocuStat Blog Post, and was starstrøkk again when on the Abels Tårn panel. The background, for both the Abels Tårn appearance and the Titan article, is the Pre-Olympic 2 x 1000 meter FocuStat Blog Post.

*feb* 2018 «Kvinner er forskjellige fra menn, rent aerodynamisk sett, forklarer professor Hjort.» Skøyteløp: Start i indre bane gir stor fordel på 1000-meteren. In *Titan*.

*feb* 2018 Skøyteløp i OL blir aldri helt rettferdig. Says Nils Lid Hjort, apparently, in *forskning.no*, 23-ii-2018.

*feb* 2018 — PRIO reblogs Nils Lid Hjort's blog post, with Towards a More Peaceful World [insert `!' or `?' here] filed under "Conflict Patterns" (and tagged with "Better Angels" and "Vietnam War").

*apr* 2018 — Jeg elsker dig! © Nils Lid Hjort – each year, a few of Nils's translations of classical song texts find their ways to official concert programme notes; the most popular remains this Grieg song, as here, with soprano R.R. Harmann, April 29 2018, for an evening recital with Love Songs, here with the Ohio Valley Symphony.

*may* 2018 — Do we need May 17th every year? «Å fjerne allround på skøyter er som å endre reglene i fotball for å legge opp til flere mål.» Kronikk, *VG*, by Arve Hjelseth (sosiolog), Iver Ørstavik (filosof), and Nils Lid Hjort (statistiker og professor, UiO).

*may* 2018 — Kunnskapsforetak? Nei takk! La oss slippe å bruke tid på dette nå igjen – vi vil forske, undervise og formidle! Kronikk, *Aftenposten*, 2-v-2018 (with Nils Lid Hjort among a string of other professors about foretaksmodellen).

*jun* 2018 — Two statisticians at the University of Oslo have blown a hole in Steven Pinker's famous theory that the Long Peace dates from 1945 onwards. A version of the Titan article, re-blogged at *PRIO*.

*jun* 2018 — The Long Peace most likely began during the Vietnam War. *Titan* [translation of earlier feature article, from Norwegian to English].

*sep* 2018 — Sørlig vågehval er avmagret. In *Klassekampen* (yes, Class Struggle, 21-ix-18), about the eleven years of statistical-political fighting within the IWC, now "won" by PhD candidate Céline Cunen and professor Nils Lid Hjort.

*sep* 2018 — Endelig enighet om at den sørlige vågehvalen er blitt avmagret. Story in *Titan*, concerning how statisticians Céline Cunen and Nils Lid Hjort entered the international and partly politicised debate on the slimming of minke whales in the Antartic, in the International Whaling Commission's Scientific Committee (and won, somehow).

*sep* 2018 — Game of Thrones and Reality: A Cross-disciplinary start of the term, at *PRIO*, with Céline Cunen giving a lecture and then being on the panel, with 125 pizza eating participants.

*dec* 2018 — Krig, fred, statistikk – om at verden er blitt fredeligere. Radio conversation in *NRK2 Studio 2*, with Nils Lid Hjort and Håvard Nygård, interviewed by Otto Haug.

*dec* 2018 — The Verden er blitt fredeligere story has been picked up by *forskning.no*, and is front page news there, the first week of December.

*dec* 2018 — December 2018: Verden er blitt fredeligere (the world has become more peaceful). Article in *Apollon*, featuring Céline Cunen, Gudmund Hermansen, Nils Lid Hjort, Håvard Nygård. See also the Apollon Theme Issue on contemporary applied statistical research, January 2019.

*dec* 2018 — Céline Cunen is the Titan Prize 2018 Awardee. In *Titan*, the University of Oslo: Prisen utdeles årlig til en forsker som har gjort en fremragende innsats med å formidle forskningen ved fakultetet. Cunen har utmerket seg ved å kommunisere om statistikk på en overbevisende, morsom, viktig og interessant måte.

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# 2019:

*jan* 2019 — In *Apollon*'s special issue on applied statistics, as many as three stories feature FocuStat work.

# Talks & Presentations

Talks and presentations given by the FocuStat participants, including also those from 2013 of relevance for the 2014-2018 project.



There's always an element of polite excitement in the hall when one of us is about to give a lecture. This is from the ISI 2013 Conference in Hong Kong, half an hour before N.L. Hjort gives his invited talk on Confidence, Likelihood, Probability.

## 2013:

- N.L. Hjort: *Mathematics, physics, probability theory and pedagogical principles in Duckburg.* (Exceedingly) popular science talk, Bjørnegildet, University of Oslo, February 2013.

- N.L. Hjort: *Statistisk dag: Confidence and Likelihood*. Tore Schweder 70 year conference, Academy of Science and Letters, Oslo, April 2013.

- M. Jullum: *Parametric or nonparametric: The FIC approach.* 17th Norwegian Statistical Meeting, Halden, June 2013.

- N.L. Hjort: *Beta-tilted Beta Processes.* Invited talk, Bayesian Nonparametrics IX, Amsterdam, June 2013.

- M. Jullum: *Parametric or nonparametric: The FIC approach.* 29th European Meeting of Statisticians, Budapest, July 2013.

- N.L. Hjort: *Confidence, Likelihood, Probability*. Invited talk, ISI World Conference, Hong Kong, August 2013.

- N.L. Hjort: *Distributions of Confidence*, Norwegian Computing Centre, Oslo, October 2013.

- N.L. Hjort: *Distributions of Confidence*. Invited talk, The International Selbu Conference, Selbu, October 2013.

- N.L. Hjort: *Distributions of Confidence*. Corcoran Lecture, Department of Statistics, Oxford University, October 2013.

- N.L. Hjort: *Who should be allowed to skate the 10,000 metre?* Fagligpedagogisk dag, University of Oslo, October 2013.

- N.L. Hjort: *Last inner track: Does one need to race the 500 metre twice?* «Fra tall til innsikt» evening with statistics, Litteraturhuset, Oslo, November 2013.

- N.L. Hjort: *Analysing an ensemble of 2 x 2 tables with many zeroes*. BMMS Statistics Seminar, November 2013.

## 2014:

- N.L. Hjort: *Quiet Does Not Flow the Don: Statistical analysis of a quarrel between Nobel laureates*. Ski og matematikk, Rondablikk høyfjellshotell, January 2014.

- N.L. Hjort: *Stille flyter ikke Don: Statistisk analyse av en krangel mellom nobelprisvinnere*. Sinus-konferansen, Cappelen-Damm, Oslo, March 2014.

- N.L. Hjort: *Distributions of confidence*. Department seminar at Norwegian Business School, April 2014.

- N.L. Hjort: *FocuStat: Focus Driven Statistical Inference with Complex Data*. Lunch seminar at the Norwegian Computing Centre, April 2014.

- N.L. Hjort: *HEL: A hybrid empirical likelihood bridging from nonparametrics to parametrics*. Invited talk at the 2nd World Conference on Nonparametric Statistics, Cadiz, June 2014.

- S.-E. Walker: *Ensemble based probabilistic forecasting of meteorology and air quality in Oslo, Norway*. Presented at WWOSC 2014: The World Weather Open Science Conference, Montréal, Canada, August 2014. (Based on work carried out with NILU, the Norwegian Institute for AirResearch.)

- N.L. Hjort: *What price Cox regression? Ranking estimates from semiparametric and parametric hazard regression models*. Invited talk at the ISCB 35, Wien, August 2014.

- N.L. Hjort: *Cross-country ski sprint cham-



Statisticians have worked out how to meet interesting people – between talks at the 60th ISI World Congress in Rio de Janeiro, Julty 2015.

pionships: how the semifinals influence the finals*. Fagligpedagogisk dag, University of Oslo, October 2014.

- N.L. Hjort: *Model comparison, model selection and model averaging*. SFI^2 Farewell Workshop, University of Oslo, November 2014.

- N.L. Hjort: *Are we in fact faced with one of the most flagrant cases of plagiarism in the history of literature?* "Mathematical pearls and curiosa" lecture, University of Trondheim, November 2014.

## 2015:

- C. Cunen: *Optimal inference via confidence distributions for two-by-two tables: presentation and comparisons with Liu, Liu, Xie methods*. International FocuStat Workshop "Inference With Confidence", Oslo, May 2015.

- K.H. Hellton: *PCA and the asymptotic distribution of high-dimensional sample eigenvectors*. International FocuStat Workshop "Inference With Confidence", Oslo, May 2015.

- G.H. Hermansen: *Predictive confidence for time series*. International FocuStat Workshop "Inference With Confidence", Oslo, May 2015.

- N.L. Hjort: *Confidence distributions for change-points*. International FocuStat Workshop "Inference With Confidence", Oslo, May 2015.

- S.-E. Walker: *Confidence distributions based on M-estimators*. International FocuStat Workshop "Inference With Confidence", Oslo, May 2015.

- C. Cunen: *Optimal inference for two-by-two tables: a confidence distribution approach*. PhD and PostDoc workshop at Klækken, May 2015.

- M. Jullum: *An approximate Bayesian geophysical inversion framework based on local-Gaussian likelihoods*. PhD and Post-Doc workshop at Klækken, May 2015.

- C. Cunen: *Optimal inference for two-by-two tables modelled as Poisson pairs: a confidence distribution approach.* 18th Norwegian Statistical Meeting, Solstrand, June 2015.

- G.H. Hermansen: *Predicting with confidence in time series processes*. 18th Norwegian Statistical Meeting, Solstrand, June 2015.

- N.L. Hjort: *On just how surprised we ought to have been when Bolt set his world records*. 18th Norwegian Statistical Meeting, Solstrand, June 2015.

- M. Jullum: *Parametric or nonparametric: The FIC approach for time series.* 18th Norwegian Statistical Meeting, Solstrand, June 2015.

- C. Cunen: *Optimal inference via confidence distributions for two-by-two tables modelled as Poisson pairs* [joint work with N.L. Hjort]. 60th ISI Conference, Rio, July 2015.

- K.H. Hellton: *Consistency of principal component scores in visualization of high-dimensional data* [joint work with M. Thoresen]. 60th ISI Conference, Rio, July 2015.

- G.H. Hermansen: *Parametric or nonparametric: the FIC approach for stationary time series* [joint work with M. Jullum and N.L. Hjort]. 60th ISI Conference, Rio, July 2015.

- N.L. Hjort: *Combining information across diverse sources via confidence distributions*. 60th ISI Conference, Rio, July 2015.

- S.-E. Walker: *Model selection and verification for ensemble based probabilistic forecasting of air pollution in Oslo, Norway* [joint work with G.H. Hermansen and N.L. Hjort]. 60th ISI Conference, Rio, July 2015.

- A. Øygard: *Deep learning "hands-on" tutorial*. Oslo Data Science Meetup. Teknologihuset, Oslo, October 2015.

- C. Cunen: *Confidence distributions: a general introduction and an application to meta-analysis of two-by-two tables* [joint work with N.L. Hjort]. Seminar at the Biostatistics group at the Norwegian University of Life Sciences, October 2015.

- N.L. Hjort: Tirant lo Blanch, 1490: *When did Author Two take over for Author One?* Fagligpedagogisk dag, University of Oslo, October 2015.

- N.L. Hjort & C. Cunen: *The World's First Novel: When did Author Two take over for Author One?* Pub med professor (og PhD-student), Realistforeningen, University of Oslo, November 2015.

## 2016:

- N.L. Hjort: *Statistikk, sannsynlighetsteori, sjansespill, samfunn, solidaritet.* Part of the ungdomsundervisningen, for 14-15 year old school pupils, organised by Humanistforeningen at UiO, February 2016.

- K.H. Hellton: *When are principal component scores a good tool for visualizing high-dimensional data?* Oberwolfach workshop, February 2016.

- C. Cunen: *When did Author Two take over for Author One?* Poster presentation, Fusion Learning & BFF, Rutgers, April 2016.

- N.L. Hjort: *Confidence distributions for change-points and regime shifts.* Invited talk, Fusion Learning & BFF, Rutgers, April 2016.

- N.L. Hjort: *Confidence, Likelihood, Probability.* Ten-hour short-course, University Bicocca, Milan, April 2016.

- N.L. Hjort: *The world's first novel, skiing days near Oslo, Kola temperatures and the Hjort time series.* University Bocconi, Milan, April 2016.

- C. Cunen: *Focused model selection for meta-analysis of 2 x 2 tables*. FICology workshop, Oslo, May 2016.

- K.H. Hellton: *The fridge: focused tuning of ridge regression.* FICology workshop, Oslo, May 2016.

- G.H. Hermansen: *Focused information criteria for time series* (with N.L. Hjort). FICology workshop, Oslo, May 2016.

- N.L. Hjort: *The hybrid likelihood: Combining parametrics and nonparametrics*. FICology workshop, Oslo, May 2016.

- M. Jullum: *FIC with a nonparametric candidate: A new strategy for FIC constructions*. FICology workshop, Oslo, May 2016.

- S.-E. Walker: *Focused inference based on robust estimators* (with N.L. Hjort). FICology workshop, Oslo, May 2016.

- C. Cunen: *The world's first novel: When did Author B take over for Author A?* Poster & flashtalk (winning one of three Best Poster Awards), NordStat 2016, København, June 2016.

- K.H. Hellton: *Integrative clustering of high-dimensional data with joint and individual clusters*. Poster & flashtalk (winning one of three Best Poster Awards), NordStat 2016, København, June 2016.

- G.H. Hermansen: *Focused model selection strategies for time series*. Poster & flashtalk, NordStat 2016, København, June 2016.

- N.L. Hjort: *The hybrid likelihood: Bridging parametrics and nonparametrics*. Invited talk, NordStat 2016, København, June 2016.

- S.-E. Walker: *Model selection and focused inference using robust estimators*. Poster & flashtalk, NordStat 2016, København, June 2016.

- C. Cunen: *When did Author B take over for Author A?* PhD Day, Oslo, June 2016.

- N.L. Hjort: *Confidence distributions and objective Bayes*. ISBA World Meeting 2016, special topics session organised by Nils, Sardegna, June 2016.

- N.L. Hjort: *Combining Information Across Diverse Sources via Confidence Distributions: the II-CC-FF Paradigm*. Invited talk, JSM2016, Chicago, August 2016.

- N.L. Hjort: *Post-Selection Distributions, Model Averaging, Bagging, Inference*. Invited talk, post-selection inference workshop, Leuven, August 2016.

- K.H. Hellton: *Fridge: a focused approach to fine-tuning ridge regression*. PhD and PostDoc workshop at Klækken, September 2016.

- E.Aa. Stoltenberg: *Estimating proportions from censored data*. PhD and PostDoc workshop at Klækken, September 2016.

- C. Cunen: *When did author B take over for author A?* Confidence Distributions and Change-Points. PhD and PostDoc workshop at Klækken, September 2016.

- K.H. Hellton: *The Fridge*. The L^\eta, Многая лета FocuStat Research Kitchen, Oslo, October 2016.

- G.H. Hermansen: *Focused Regularised Likelihood*. The L^\eta, Многая лета FocuStat Research Kitchen, Oslo, October 2016.

- N.L. Hjort: *Minimum dispair, maximum despair*. The L^\eta, Многая лета FocuStat Research Kitchen, Oslo, October 2016.

- S.-E. Walker: *Minimum disparity estimators*. The L^\eta, Многая лета FocuStat Research Kitchen, Oslo, October 2016.



With Sonia Petrone and Igor Prünster, Bayesian Nonparametrics Bridging at Bislett, May 2017.

- C. Cunen: *Statistikk for the Game of Thrones*. Fagligpedagogisk dag, University of Oslo, November 2016.

## 2017:

- K.H. Hellton: *Pop-Mat: 7 søyler med statistisk visdom*. Matematisk fagutvalg, UiO, January 2017.
- N.L. Hjort: *Model selection and model averaging* (2 hrs). Geilo Winter School, January 2017.
- N.L. Hjort: *Confidence distributions and data fusion* (2 hrs). Geilo Winter School, January 2017.
- N.L. Hjort: *Bayesian nonparametrics* (2 hrs). Geilo Winter School, January 2017.
- C. Cunen: *The world's first novel: When did Author B take over for Author A?* Poster presentation, Geilo Winter School, January 2017.
- V. Ko: Interview session about the book *Met hartelijke groente*, with Wim Daniëls, Wim Daniëls boekt, Boxmeer, January 2017.
- N.L. Hjort: *A gentle introduction to Bayesian Nonparametrics*. Big Insight Lunch Talk, February 2017.
- K.H. Hellton: *p-verdier*. Metodemøte, Nasjonal kompetansetjeneste for kvinnehelse, February 2017.
- K.H. Hellton: *p-values: what's the problem?* Symposium of the IMB PhD Forum, February 2017.
- C. Cunen: Er Game of Thrones blodigere enn middelalderkriger? An «åpen dag» University of Oslo lecture, also shown (and kept) on television, NRK Skole, April 2017.
- N.L. Hjort: Data fusion with confidence curves: The II-CC-FF paradim. The BFF4 conference, Harvard University, May 2017.
- C. Cunen: Analysis of fat weights: Three new wide models. Presentation for the Scientific Committee of the International Whaling Commision, Bled, May 2017.
- C. Cunen: No paradox: Explaining how we can observe a decrease in fat weight, while the total weight appears to remain constant. Presentation for the Scientific Committee of the International Whaling Commision, Bled, May 2017.
- C. Cunen: Decline in energy storage in Antarctic Minke whales during the JARPA period: Assessment via the Focused Information Criterion (FIC) [with Lars Walløe and Nils Lid Hjort]. Presentation for the Scientific Committee of the International Whaling Commision, Bled, May 2017.
- C. Cunen: *Confidence distributions: A potential bridge for combining parametric and nonparametric analyses*. FocuStat BBB workshop, May 2017.
- K.H. Hellton: *Focused Fine-tuning of Ridge Regression for Personalised Prediction*. FocuStat BBB workshop, May 2017.
- G.H. Hermansen: *Focused regularised likelihood*. FocuStat BBB workshop, May 2017.
- N.L. Hjort: *The hybrid likelihood*. FocuStat BBB workshop, May 2017.
- N.L. Hjort: *Minimum Dispair, Maximum Despair*. FocuStat BBB workshop, May 2017.
- N.L. Hjort: *Building Bridges (at Bislett): general workshop themes*. FocuStat BBB workshop, May 2017.
- V. Ko: *Focused information criteria for copulae*. FocuStat BBB workshop, May 2017.
- E.Aa. Stoltenberg: *Inference in misspecified cure models*. FocuStat BBB workshop, May 2017.
- S.-E. Walker: *Focused model selection and inference using robust estimators* (with N.L. Hjort). FocuStat BBB workshop, May 2017.
- C. Cunen: *Are the death rates in Game of Thrones realistic? A statistical case-study*. Oslo Data Science Meetup, May 2017.
- C. Cunen: *Combining diverse information sources with the II-CC- FF paradigm*. The 19th national meeting of the NSF, Fredrikstad, June 2017.
- K.H. Hellton: *Fridge: focused fine-tuning of ridge regression for personalized prediction*. The 19th national meeting of the NSF, Fredrikstad, June 2017.
- G.H. Hermansen: *Focused Regularised Likelihood*. The 19th national meeting of the NSF, Fredrikstad, June 2017.
- N.L. Hjort: *The semifinals factor for skiing fast in the finals*. The 19th national meeting of the NSF, Fredrikstad, June 2017.
- E.Aa. Stoltenberg: *Selecting the failure time distribution in cure models*. The 19th national meeting of the NSF, Fredrikstad, June 2017.
- S.-E. Walker: *Estimation and model selection by data-driven maximum weighted likelihood*. The 19th national meeting of the NSF, Fredrikstad, June 2017.
- N.L. Hjort: *Empirical Likelihood and Bayesian Nonparametrics*. Invited talk, the 11th Bayesian Nonparametrics Conference, Paris, June 2017.
- G.H. Hermansen: Бернштейн–von Mises theorems for a class of Bayesian nonparametric setups for stationary time series. Poster presentation [with hours of wine and shouting], the 11th Bayesian Nonparametrics Conference, Paris, June 2017.
- C. Cunen: *Combining diverse information sources with the II-CC-FF paradigm: Independent Inspection, Confidence Conversion, Focused Fusion.* Invited talk, the 61st ISI World Conference, Marrakech, Marocco, July 2017.
- K.H. Hellton (with N.L. Hjort): *Focused Fine-tuning of Ridge Regression for Personalized Prediction*. Contributed paper and presentation, JSM, Baltimore, July-August 2017.
- N.L. Hjort (with C. Cunen and G. Hermansen): *Confidence distributions for change-points and regime shifts*. Invited talk, in an Invited session on Complex risk structures or constraints of reliability of systems; JSM, Baltimore, July- August 2017.
- C. Cunen (with N.L. Hjort): *Combining diverse information sources with the II-CC-FF paradigm: New developments*. Invited talk, in an Invited session, organised by Nils, on BFF in Action; JSM, Baltimore, July-August 2017. [The talk was well



Cunen gives her invited talk on combination of diverse information sources, under the high patronage of His Majesty King Mohammed VI, at the 61st ISI World Congress in Marrakech, July 2017.

prepared (see the link), but not actually given; Cunen chose not to take part (see her statement of page 2); Hjort was ill on that day of the conference.]

- S.-E. Walker (with N.L. Hjort): *Estimation and model selection by data-driven weighted likelihood.* Poster and speed presentation, JSM, Baltimore, July-August 2017.
- C. Cunen: *Game of Thrones vs the Wars of Roses: Survival and competing risks.* Sylvia Richardson Honoris Causa workshop, UiO, August 2017.
- K.H. Hellton: *Personalized prediction through focused fine-tuning of ridge regression*. Sylvia Richardson Honoris Causa workshop, UiO, August 2017.
- N.L. Hjort: *All models are wrong, but some are more biologically plausible than others: Survival analysis models based on crossing times for cumulative damage processes*. Sylvia Richardson Honoris Causa workshop, UiO, August 2017.
- E.Aa. Stoltenberg: *Some insight into the cure model.* Sylvia Richardson Honoris Causa workshop, UiO, August 2017.
- C. Cunen: *Combining diverse information sources with the II-CC-FF paradigm*. Statistics seminar, MRC Biostatistics Unit, Cambridge, September 2017.
- C. Cunen: Død, vold og statistikk: *Game of Thrones vs. Rosekrigene*. Kaplah! Vol. 5, Tilt, Oslo, October 2017.
- V. Ko: Interview session about the book *Met hartelijke groente*, Library Alphen aan den Rijn, October 2017.
- N.L. Hjort: *Whales, politics, and statisticians*. Fagligpedagogisk dag, UiO, November 2017.
- E.Aa. Stoltenberg: *Two approaches to statistics*. Fagligpedagogisk dag, UiO, November 2017.
- C. Cunen: *Gamma process models for competing risks*. The From Processes to Models FocuStat Research Kitchen, Oslo, November 2017.
- N.L. Hjort: *From Processes to Models: a mini-review*. The From Processes to Models

FocuStat Research Kitchen, Oslo, November 2017.

- N.L. Hjort: *Some Gamma process based models for survival data*. The From Processes to Models FocuStat Research Kitchen, Oslo, November 2017.

- R. Parviero: *Playing basketball via simulated Markov chains*. The From Processes to Models FocuStat Research Kitchen, Oslo, November 2017.

- E.Aa. Stoltenberg: *Cure models and path dependent hazard rates*. The From Processes to Models FocuStat Research Kitchen, Oslo, November 2017.

- C. Cunen: *Combining diverse information sources with the II-CC-FF paradigm, with applications in meta-analysis & beyond*. London School of Hygiene & Tropical Medicine, November 2017.

- K.H. Hellton: *Significance for a modern world*. Big Insight Lunch Talk, Norwegian Computing Centre, December 2017.

## 2018:

- N.L. Hjort: *Discussion of Clauset's `Trends and Fluctuations'*. PRIO, Oslo Lectures on Peace and Conflict, January 2018.

- G.H. Hermansen: *Big data: Hva er likheten mellom epigenetikk og bildegjenkjenning?* The University of Oslo's Åpen Dag, March 2018.

- N.L. Hjort: *One Thousand is Unfair, Two Thousand is Fair*. Matematisk felleskollokvium, Department of Mathematics, UiO, March 2018.

- F. Ferraccioli: *Nonparametric penalized likelihood for density estimation*. Statistics seminar talk, Department of Mathematics, UiO, April 2018.

- E.Aa. Stoltenberg (with N.L. Hjort): *Models and inference for on-and-off data via clipped Ornstein-Uhlenbeck processes*. Poster presentation, New Aspects of Statistics, Financial Econometrics, and Data Science. Spring Conference, Stevanovich Center, University of Chicago, May 2018.

- C. Cunen: *Whales, politics, and statisticians* [joint work with N.L. Hjort and L. Walløe]. FocuStat VVV Conference, Ingeniørenes Hus, May 2018.

- K.H. Hellton: *High-dimensional asymptotics of principal component regression*. FocuStat VVV Conference, Ingeniørenes Hus, May 2018.

- G.H. Hermansen: *Bayesian nonparametrics for stationary time series* [joint work with N.L. Hjort]. FocuStat VVV Conference, Ingeniørenes Hus, May 2018.

- N.L. Hjort: *Welcoming remarks & introduction to the FocuStat VVV themes* (touching also Lessons A, B, C, D from the Birkeland-Eyde world). FocuStat VVV Conference, Ingeniørenes Hus, May 2018.

- N.L. Hjort: *Survival and event history models via Gamma processes* [joint work with C. Cunen]. FocuStat VVV Conference, Ingeniørenes Hus, May 2018.

- M. Jullum: *Parametric or nonparametric,*

*that's the question* [joint work with Nils Lid Hjort]. FocuStat VVV Conference, Ingeniørenes Hus, May 2018.

- V. Ko: *FIC for copulae* [joint work with Nils Lid Hjort]. FocuStat VVV Conference, Ingeniørenes Hus, May 2018.

- T. Schweder: *Unbiased confidence*. FocuStat VVV Conference, Ingeniørenes Hus, May 2018.

- E.Aa. Stoltenberg: *Models and inference for on-off data via clipped Ornstein-Uhlenbeck processes* [joint work with N.L. Hjort]. FocuStat VVV Conference, Ingeniørenes Hus, May 2018.

- C. Cunen: *II-CC-FF: Combination of information beyond meta-analysis* [joint with N.L. Hjort]. NordStat, Tartu (with Cunen as invited organiser for a session on CDs and related themes), June 2018.

- G.H. Hermansen: *Peacekeeping operations and the intensity of violence in internal armed conflict* [joint work with H. Nygård]. NordStat, Tartu, June 2018.

- N.L. Hjort: *Prediction and confidence*. NordStat, Tartu, June 2018.

- V. Ko: *Focused information criterion for copula* [joint work with N.L. Hjort]. NordStat, Tartu, June 2018.

- E.Aa. Stoltenberg: *Models and inference for on-off data via clipped Ornstein-Uhlenbeck processes* [joint work with N.L. Hjort]. NordStat, Tartu, June 2018.

- S.-E. Walker: *Focused model selection and inference using robust estimators* [joint work with N.L. Hjort]. NordStat, Tartu, June 2018.

- K.H. Hellton: *Fridge: Focused fine-tuning of ridge regression for personalized predictions* [joint work with Nils Lid Hjort]. CompStat, Iași, Romania, August 2018.

- C. Cunen: *Når startet Den lange freden?* [joint work with N.L. Hjort and H. Nygård] Invited opening talk at the Annual Alumni Celebrations of the Department of Mathematics, University of Oslo, September 2018.

- C. Cunen: *Game of Thrones and Reality*. PRIO, one of three lectures, followed by a one-hour panel discussion, also with questions from the plus-hundred audience. September 2018.

- C. Cunen, with N.L. Hjort and H. Nygård: Statistical Sightings of Better Angels. Brown-bag G-35 lunch seminar at PRIO, discussing the paper. October 2018.

- C. Cunen: *II-CC-FF – Combination of information beyond meta-analysis* [joint work with N.L. Hjort]. PhD and PostDoc workshop at Klækken, October 2018.

- N.L. Hjort: *War, Peace, and Statisticians*. Fagligpedagogisk dag, UiO, November 2018.

- C. Cunen and N.L. Hjort: *Statistical Sightings of Better Angels*. Statistics seminar (in stereo), BI Norwegian Business School, November 2018.

- K.H. Hellton: *Focused fine-tuning of ridge regression with data integration*. FocuStat Combo Kitchen, November 2018.

- N.L. Hjort: *Olympic unfairness – analysing 2 x 1000 m speedskating races*. FocuStat Combo Kitchen, November 2018.



A biased subset of Statisticians Against War, at BI, November 2018: Hermansen, Haug, Cunen, Hjort, with Cunen and Hjort giving an invited joint seminar talk.

- N.L. Hjort (with F. Aakre): *Dolce and Largo*, from Telemann's F major duet for alto recorders. FocuStat Combo Kitchen, November 2018.

- C. Cunen: *II-CC-FF – combination of information beyond meta-analysis*. FocuStat Combo Kitchen, November 2018.

- K.H. Hellton: *Combination of information across diverse sources: An overview*. FocuStat Combo Kitchen, November 2018.

- C. Cunen: *Freedman's Paradox*. Trial lecture for her PhD disputation. Department of Mathematics, University of Oslo, December, 2018.

- C. Cunen: *Wars and Whales: Extensions and Applications of Confidence Curves and Focused Model Selection*. Introduction to the public attack-and-defense disputation of her PhD dissertation. Department of Mathematics, University of Oslo, December, 2018.

- K.H. Hellton: *The Fridge: focused fine-tuning of ridge regression for personalised predictions*. Computational and Methodological Statistics, Pisa, December, 2018.



Brad Efron, Regina Liu, and N.L. Hjort, invited speakers at the BFF.

# Publications

Publications by the FocuStat
participants, including also those
from 2013 of relevance
for the 2014-2018 project.



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Books, journal articles, technical
reports, blog posts, pamphlets,
fliers, FocuStat Notes, libretti,
statistical poems, symposiae
proceedings, and yet further names
of the publication games: Here we
list publications by the FocuStat
participants, including also those
from 2013 of relevance for the
2014-2018 project.

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- Argyrou, J. (2017). Topics in Confidence Distributions. Master's thesis (supervisor: N.L. Hjort), Department of Mathematics, University of Oslo.

- Barua, S. (2017). Inverse covariance matrix estimation for the global minimum variance portfolio. Master's Thesis, Department of Mathematics, UiO (supervisors: I.K. Glad and N.L. Hjort).

- Bjørvik, L.M., Dale, S., Hermansen, G.H., Munishi, P.K.T., Moe, S.R. (2015). Bird flight initiation distances in relation to distance from human settlements in a Tanzanian floodplain. Journal of Ornithology, 156, 239-246.

- Cunen, C. (2014). Three PLS-based methods for variable ranking and interaction detection. Master thesis, Norwegian University of Life Sciences.

- Cunen, C. (2015). Mortality and Nobility in the Wars of the Roses and Game of Thrones. FocuStat Blog Post, October 2015.

- Cunen, C. (2015). The impact of philosophy of science: A citation analysis. Exam essay, Science, Ethics, Society PhD course mnses 9100, December 2015.

- Cunen, C. (2017). Analysis of fat weights: Three new wide models. Reports of the Scientific Committee of the International Whaling Commision SC/67A/EM/08.

- Cunen, C. (2017). No paradox: Explaining how we can observe a decrease in fat weight, while the total weight appears to remain constant. Reports of the Scientific Committee of the International Whaling Commision SC/67A/EM/07.

- Cunen, C. (2018). Wars and Whales: Extensions and Applications of Confidence Curves and Focused Model Selection.

- Introduction chapter (the so-called kappen) to her PhD dissertation, Department of Mathematics, University of Oslo, December 2018.

- Cunen, C. (2018). Wars and Whales: Extensions and Applicatiaons of Confidence Curves and Focused Model Selection. The full PhD dissertation (supervisor: N.L. Hjort), defended December 2018, Department of Mathematics, University of Oslo.

- Cunen, C., Hermansen, G.H., Stoltenberg, E.Aa. (2017). Bokmelding: T. Schweder and N.L. Hjort's Confidence, Likelihood, Probability (Cambridge University Press, 2016). FocuStat Blog Post, November 2017.

- Cunen, C., Hermansen, G., Stoltenberg, E.Aa. (2017). Book review: T. Schweder and N.L. Hjort's Confidence, Likelihood, Probability: Statistical Inference With Confidence Distributions (Cambridge University Press, 2016). Tilfeldig Gang, nr 1, juni 2017, pages 9-12.

- Cunen, C., Hermansen, G.H., Hjort, N.L. (2018). Confidence distributions for change-points and regime shifts. Journal of Statistical Planning and Inference 195, 14-34.

- Cunen, C., Hjort, N.L. (2015). Optimal inference via confidence distributions for two-by-two tables modelled as Poisson pairs: Fixed and random effects. [For the Rio 60th World Statistics Congress.]

- Cunen, C., Hjort, N.L. (2017). New statistical methods shed light on medieval literary mystery. FocuStat Blog Post, January 2017.

- Cunen, C., Hjort, N.L. (2018). Whales, Politics, and Statisticians. FocuStat Blog Post, January 2018.

- Cunen, C., Hjort, N.L. (2016). Combining information across diverse sources: The II-CC-FF paradigm. Proceedings from the

Joint Statistical Meeting 2016, the American Statistical Association, 138–153. The JSM took place in Chicago, July 29 to August 4, where Hjort was an invited speaker in the specially invited session 'Bridging Bayesian/Frequentist/Fiducial Inference in the Era of Data Science'.

- Cunen, C., Hjort, N.L. (2018). Combining information across diverse sources: the II-CC-FF paradigm. Statistical Research Report, Department of Mathematics, UiO, September 2018 (submitted for publication).

- Cunen, C., Hjort, N.L., Nygård, H. (2018). Statistical Sightings of Better Angels: Analysing the Distribution of Battle Deaths in Interstate Conflict over Time. Journal of Peace Research [to appear].

- Cunen, C., Walløe, L., Konishi, K., Hjort, N.L. (2018). Supplementary notes and material, with some refined analyses, compared to our IWC/SC/67A/EM04 May 2017 report. Report to the Scientific Committee of the International Whaling Commission, Bled, May 2018: SC/67/EM/02.

- Cunen, C., Walløe, L., Hjort, N.L. (2017). Decline in energy storage in Antarctic Minke whales during the JARPA period: Assessment via the Focused Information Criterion (FIC). Reports of the Scientific Committee of the International Whaling Commision SC/67A/EM/04.

- Cunen, C., Walløe, L., Hjort, N.L. (2018). Reactions and answers to two papers by McKinlay, de la Mare and Welsh. Report to the Scientific Committee of the International Whaling Commission, Bled, May 2018: SC/67B/EM/08.

- Cunen, C., Walløe, L., Hjort, N.L. (2018). Focused model selection for linear mixed models, with an application to whale ecology. Submitted for publication.

- Garcia-Magarios, M., Egeland, T., Lopez-de-Ullibarri, Hjort, N.L., Salas, A. (2015). A parametric approach to kinship hypothesis testing using identity-by-descent parameters. Statistical Applications in Genetics and Molecular Biology, 14, 465-479.

- Giil, L.M., Solvang, S.-E. H., Giil, M.M., Hellton, K.H., Skogseth, R.E., Vik-Mo, A.O., Hortobagyi, T., Aarsland, D., Nordrehaug, J.E. (2018). Serum potassium is associated with cognitive decline in patients with Lewy Body Dementia. Journal of Alzheimer's Disease.

- Giil, L., Aarsland, D., Hellton, K.H., Lund, A., Heidecke, H., Schulze-Forster, K., Riemekasten, G., Vik-Mo, A.O., Kristoffersen, E.K., Vedeler, C.A., Nordrehaug, J.E. (2018). Antibodies to multiple receptors are associated with neuropsychiatric symptoms and mortality in Alzheimer's disease: a longitudinal study. Journal of Alzheimer's Disease, 64, 761-774.

- Glad, I.K., Hjort, N.L. (2016). Model uncertainty first, not afterwards. Discussion contribution to the article 'Approximate models and robust decisions' by J. Watson and C. Holmes. Statistical Science 31, 490-494.

- Grønneberg, S., Hjort, N.L. (2014). The Copula Information Criteria. Scandinavian Journal of Statistics, 41, 436-459.

- Hauge, V.L., Hermansen, G.H. (2017). Machine Learning methods for sweet spot detection: a case study. Quantitative Geology and Geostatistics, 19, 573-588.

- Hellton, K.H. (2014). On High-Dimensional Principal Component Analysis in Genomics: Consistency and Robustness. PhD Dissertation (supervisors: M. Thoresen and A. Frigessi), Department of Biostatistics, UiO.

- Hellton, K.H. (2015). Hvor stemmes det hva i hovedstaden? FocuStat Blog Post, September 2015. Hellton, K.H. (2015). The bonus roll and the Christmas spirit. FocuStat Blog Post, December 2015.

- Hellton, K.H., Cummings, J., Vik-Moe, A.O., Nordrehaug, J.E., Aarsland, D., Selbaek, G., Giil, L.M. (2018). The truth behind the zeros: A new approach to Principal Component Analysis of the neuropsychiatric inventory. Submitted for publication.

- Hellton, K.H., Hjort, N.L. (2018). Fridge: Focused Finetuning of Ridge Regression for Personalized Predictions. Statistics in Medicine 37, 1290-1303.

- Hellton, K.H., Røislien, J. (2017). Verdens første p-verdi. Tidsskrift for Den norske legeforening, årgang 137, mai 2017.

- Hellton, K.H., Thoresen, M. (2014). The impact of measurement error on principal component analysis. Scandinavian Journal of Statistics, 41, 1051-1063.

- Hellton, K.H., Thoresen, M. (2015). Consistency of principal component scores in visualizations of high-dimensional data. [For the Rio 60th World Statistics Congress.]

- Hellton, K.H., Thoresen, M. (2016). Integrative clustering of high-dimensional data with joint and individual clusters. Biostatistics 17, 537-548.

- Hellton, K.H., Thoresen, M. (2017). When and why are principal component scores a good tool for visualizing high-dimensional data? Scandinavian Journal of Statistics, 44, 581-597.

- Hellton, K.H. (2015). The bonus roll and the Christmas spirit. FocuStat Blog Post, December 2015.

- Hermansen, G.H. (2014). Model Selection and Bayesian Nonparametrics for Time Series and Nonstandard Regression Models. PhD dissertation (supervisor: N.L. Hjort), defended September 2014, Department of Mathematics, University of Oslo.

- Hermansen, G.H., Hjort, N.L. (2015). Bernstein-von Mises theorems for nonparametric function analysis via locally constant modelling: A unified approach. Journal of Statistical Planning and Inference, 166, 138-157.

- Hermansen, G.H., Hjort, N.L. (2014). Focused information criteria for time series. Statistical Research Report, Department of Mathematics, University of Oslo.

- Hermansen, G.H., Hjort, N.L., Jullum, M. (2015). Parametric or nonparametric: The FIC approach for stationary time series. [For the Rio 60th World Statistics Congress.]

- Hermansen, G., Hjort, N.L., Jullum, M. (2015). Parametric or nonparametric: The FIC approach for time series. Technical report, Department of Mathematics, University of Oslo. [Extended and further developed 21-page version of a six-page story we've published in the ISI 2015 Rio de Janeiro proceedings.]

- Hermansen, G., Hjort, N.L., Kjesbu, O. (2016). Recent advances in statistical methodology applied to the Hjort liver index time series (1859-2012) and associated influential factors. Canadian Journal of Fisheries and Aquatic Sciences 73, 279–295. This is part of the special issue based on the Johan Hjort Symposium on Recruitment Dynamics and Stock Variability, Bergen, Norway, 7–9 October 2014.

- Hjort, N.L. (2014). Discussion of Efron's 'Estimation and accuracy after model selection'. Journal of the American Statistical Association, 110, 1017-1020.

- Hjort, N.L. (2014). Deilig er jorden. In Ad Fontes, festschrift for Terje Kvam, 101-103.

- Hjort, N.L. (2015). Norway-Spain 28-25: How exciting was it? FocuStat Blog Post, September 2015.

- Hjort, N.L. (2015). Conspiracy Probability Calculus for Norwegian Footballers. FocuStat Blog Post, October 2015.

- Hjort, N.L. (2016). Recruitment Dynamics and Stock Variability: The Johan Hjort Symposium, some personal reflections. FocuStat Blog Post, April 2016.

- Hjort, N.L. (2016). Rapport fra NordStat 2016, København 27.-30. juni. In Tilfeldig Gang, December 2016 issue, pages 7-8.

- Hjort, N.L. (2017). But some are more equal than others. FocuStat Blog post, January 2017.

- Hjort, N.L. (2017). The semifinals factor for skiing fast in the finals. FocuStat Blog Post, February 2017. Hjort, N.L. (2017). Ut på tur: NordStat, København, juni 2016. FocuStat Blog Post, February 2017.

- Hjort, N.L. (2017). Cooling of Newborns and the Difference Between 0.244 and 0.278. FocuStat Blog Post, December 2017.

- Hjort, N.L. (2018). Towards a More Peaceful World [insert 'I' or '?' here]. FocuStat Blog Post, January 2018.

- Hjort, N.L. (2018). One Thousand is Unfair, Two Thousand is Fair. Pre-Olympic FocuStat Blog Post, February 2018. Hjort, N.L. (2018). The Best Metal-Grabbing Games Ever. Post-Olympic FocuStat Blog Post, February 2018.

- Hjort, N.L. (2018). Belgium Breaks a 48 Year Old Curse (Apparently). FocuStat Blog Post, July 2018. Hjort, N.L. (2018). Overdispersed Children. FocuStat Blog Post, August 2018.

- Hjort, N.L. (2016). Exercises & Lecture Notes STK 4180, for the master-and-PhD course on Confidence Distributions.

- Hjort, N.L. (2017). Exercises & Lecture Notes STK 4021, for the master-and-PhD course on Model Selection and Model Averaging.

- Hjort, N.L. (2017). Exercises & Lecture Notes STK 4160, for the master-and-PhD course on Model Selection and Model Averaging.

- Hjort, N.L. (2018). Exercises & Lecture Notes STK 9190, for the master-and-PhD course on Bayesian Nonparametrics.

- Hjort, N.L. (2018). Exercises & Lecture Notes STK 4080, for the master-and-PhD course on Survival Analysis and Event History Analysis.

- Hjort, N.L., McKeague, I.W., Van Keilegom, I. (2018). Hybrid combinations of parametric and empirical likelihoods. Statistica Sinica, 28, 2389-2407. Complete with a Supplementary Material online section. Our paper is for Sinica's Peter Hall volume, and in the introduction section Hjort also reports briefly on Peter's visit to Oslo in 2003.

- Hjort, N.L., Schweder, T. (2018). Confidence distributions and related themes. General introduction article to a Special Issue of the Journal of Statistical Planning and Inference dedicated to this topic, with eleven articles, and with Hjort and Schweder as guest editors; vol. 195, 1-13.

- Hjort, N.L., Sørensen, Ø. (2018). Rikdom og pengenes verdi i Andeby (Being rich, and the value of money, in Duckburg). Donald Duck, De komplette årgangene (volume 1976, part VI), Egmont, Walt Disney, November 2018.

- Hjort, N.L., Walker, S.-E. (2019). Estimation and model selection via weighted likelihoods. Manuscript.

- Jullum, M. (2016). New Focused Approaches to Topics Within Model Selection and Approximate Bayesian Inverstion. PhD dissertation (supervisors: N.L. Hjort and O. Kolbjørnsen), defended April 2016, Department of Mathematics, University of Oslo.

- Jullum, M., Baños, D.R., Hjort, N.L. (2015). To liv: kvinnene i Lillestrøm som ble født på samme dag og døde på samme dag. FocuStat Blog Post, October 2015.

- Jullum, M., Hjort, N.L. (2017). Parametric or nonparametric: The FIC approach. Statis-

tica Sinica, 27, 951–981. With Supplementary Material (19 pages).

- Jullum, M., Hjort, N.L. (2018). What price semiparametric Cox regression? Lifetime Data Analysis, 24, 1-33. With Supplementary Material (7 pages).

- Jullum, M., Kolbjørnsen, O. (2016). A Gaussian based framework for local Bayesian inversion of geophysical data to rock properties. Geophysics, 81, 75-87.

- Ko, V., Wieling, M., Wit, E., Nerbonne, J., Krijnen, W. (2014). Social, geographical, and lexical influences on Dutch dialect pronunciations. Computational Linguistics in the Netherlands Journal, 4, 29-38.

- Ko, V. (2016). Met hartelijke groente. Nederlands door Koreanse ogen. Uitgeverij Podium, Amsterdam (175 pages). [No, FocuStat can't take any credit for this at all, but we feel Vinnie's book belongs on our publication list, nevertheless.]

- Ko, V., Hjort, N.L. (2019). Model robust inference with two-stage maximum likelihood estimation for copulae. Journal of Multivariate Analysis [to appear].

- Ko, V., Hjort, N.L. (2019). Copula information criterion for model selection with two-stage maximum likelihood estimators. Econometrics and Statistics [to appear].

- Ko, V., Hjort, N.L., Hobæk Haff, I. (2019). Focused information criteria for copulae. Scandinavian Journal of Statistics [to appear].

- Løland, A., Huseby, R.B., Hjort, N.L., Frigessi, A. (2013). Statistical corrections of invalid correlation matrices. Scandinavian Journal of Statistics, 40, 807-824.

- Moss, J. (2015). Cube Root Asymptotics. Master Thesis in statistics (supervisor: N.L. Hjort), Department of Mathematics, University of Oslo.

- Olsen, H.G., Hermansen, G.H. (2017). Recent advancements to nonparametric nodeling of interactions between reservoir parameters. Quantitative Geology and Geostatistics, 19, 653-669.

- Parviero, R. (2018). Improving Ridge Regression via Model Selection and Focussed Fine-Tuning. Tesi de laurea magistrale, Università degli Studi di Milano-Bicocca (supervisors: K.H. Hellton and N.L. Hjort), March 2018.

- Rønneberg, L.T.S. (2017). Fiducial and Objective Inference: History, Theory, and Comparisons. Master thesis in statistics (supervisor: N.L. Hjort), Department of Mathematics, University of Oslo.

- Schweder, T. (2017). Bayesian Analysis: Always and Everywhere? FocuStat Blog Post, November 2017.

- Schweder, T., Hjort, N.L. (2013). Discussion of 'Confidence distribution, the frequentist distribution estimator of a parameter: A review'. International Statistical Review, 81, 56-68.

- Schweder, T., Hjort, N.L. (2016). Confidence, Likelihood, Probability. Statistical Inference with Confidence Distributions. Cambridge University Press (500 pages).

- Solberg, S., Walker, S.-E., Schneider, P., Guerreiro, C., Colette, A. (2018). Discount-ing the effect of meteorology on trends in surface ozone: Development of statistical tools. ETC/ACM Technical Paper.

- Stoltenberg, E. Aa. (2015). The c-Loss Function: Balancing Total and Individual Risk in the Simultaneous Estimation of Poisson Means. Master Thesis in statistics (supervisor: N.L. Hjort), Department of Mathematics, University of Oslo.

- Stoltenberg, E.Aa. (2017). Objectivity, rationality and statistics. Exam essay for the Science, Ethics, Society PhD course mnses 9100, December 2017.

- Stoltenberg, E. Aa. (2017). Frekventisme, Bayes og likelihoodprinsippet. Filosfisk supplement, 2 (special issue on the Philosophy of Mathematics), 58-65.

- Stoltenberg, E.Aa. (2017). Frekventisme, Bayes og likelihoodprinsippet. FocuStat Blog Post, July 2017.

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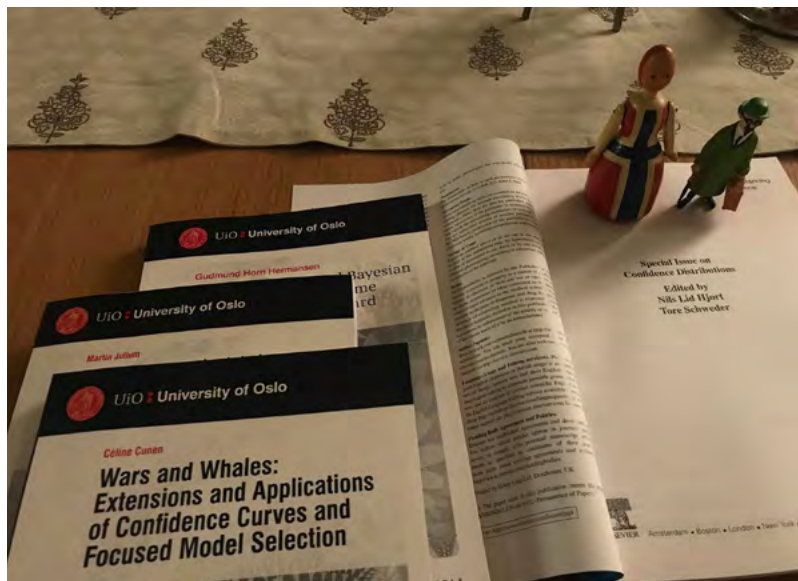
Three PhD dissertations, with several more to come in 2019 and 2020, and the Special Issue of *Journal of Statistical Planning and Inference* which started with our FocuStat Workshop "Inference With Confidence".

Stoltenberg, Ko, Hjort, Cunen, Hermansen, Parviero, this time at Litteraturhuset.



"nils hjort with his latest book", tweets Cambridge University Press, at JSM 2016.



Hjort, Cunen, Moss, Stoltenberg, Hellton, after Brahms A minor.



"with absolutely fantastic talks from Nils Hjort and Art Owen", blogs Christian Robert from Paris.



Nils blogs on Overdispersed and Markovian Children.



TTT at the VVV.



Another end-of-semester party.



Cunen, Hellton, Hermansen, still smiling, close to midnight, after a long working day.



Inderdaad.



FocuStat wins the department quiz: Hellton, Ko, Cunen, Moss, Stoltenberg, Hobæk Haff, Hjort.



Walker finesses his plan for completing the FRIC paper with Hjort.



Ready for twelve verses of FocuStats røst, in D minor.

# FocuStat
# after FocuStat

The Vårens Vakreste Variabler participants, May 2018.

**WE HAVE BEEN** privileged with the generous funding awarded us by the Norwegian Research Council. It has allowed us not only woman- and manpower, qua PostDocs and PhDs and associated colleagues and Master level students, but the flexibility to investigate broader horizons and to build lasting friendships and networks, nationally and internationally. In particular, our workshops and the VVV conference, along with our research kitchens, have been fruitful, inspiring, and productive, leading to new ideas and to collaboration projects.

**IN SOME PRACTICAL**, work-wise, and sociological senses the FocuStat project will live on, also as it will pave the way towards new themes, challenges, and constellations. The FocuStat website will

continue to exist, as will in particular the FocuStat Blog pages, with new Statistical Stories. The core group shall continue to meet regularly, with «runde rundt bordet» and the necessary time to discuss new ideas, partly using our favourite technology of chalk, blackboard, and sponge.

**TWO IDENTIFIABLE LARGER** research themes on our desks and blackboards are as follows. First, From Processes to Models, having to do with constructing classes of plausible stochastic processes "behind the data", e.g. in biological or biostatistical settings. Thus, instead of applying off-the-shelf methods for a survival regression dataset, for example, we delve into the underlying mechanisms, to build better and more context-relevant models for such data. Can we

ProcMod such data?, becomes an operative research question. N.L. Hjort shall be applying for funding for a well-built ProcMod project, in that case hosting new PostDocs and room for extensive collaboration. Second, together with Håvard Nygård at the Peace Research Institute Oslo, we're seeking funding for Stability and Change. This project aims at developing methodology for understanding the complex processes of armed conflicts, as these develop over time, in country after country, influenced by a multitude of interacting factors. What causes change points and regime shifts, what might be enough to secure relative stability? The envisaged methodology will be eminently useful also for other application areas, including biomedicine.