Bernoulli News

Newsletter of the Bernoulli Society For Mathematical Statistics and Probability

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Contents

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A VIEW FROM THE PRESIDENT

Dear Members of the Bernoulli Society,

The Ninth IMS/BS World Congress in Probability and Statistics was held in Toronto and is now part of our proud history. The First World Congress was in 1986 in Tashkent, with the 'greetings' of the great mathematician Andrey Kolmogorov who could not come in person due to illness. I believe he wasn't the only person not feeling well: the story goes that many people were not quite used to the Uzbekistan food.

At the Toronto conference there were several named lectures in probability and statistics, one of them being the Tukey Lecture. It was presented by the famous statistician David Brillinger. David gave in his Tukey lecture a beautiful account of the person John Tukey. Apart from being a data-detective ("Analyzing Data: Sanctification or Detective Work?" *Am. Psychol.* 24, 83–91, 1969) John Tukey was for instance U.S. Delegate to Technical Working Group 2 of the U.S.–U.S.S.R. Conference on the Discontinuance of Nuclear Weapon Tests and Member of the President's Science Advisory Committee reporting "Restoring the Quality of Our Environment" and "Chemicals and Health." He was co-author of numerous other reports, for example The Kinsey report, following Kinsey's book "Sexual Behavior in the Human Male." It was really impressing to learn about his devotion to societal affairs and his great influence. My hypothesis (H_1) is that actually many of our colleagues have or had significant impact beyond their (our) field. To be tested. But if H_1 is true then maybe this is because randomness is everywhere but so difficult to understand. Experts on randomness are very much in demand. Experts may be applying probability and statistics but they also have a very careful way of thinking. Here is another great name: the theoretical physicist Richard Feynman. He wrote:

> "… there is no sense in calculating the probability or chance that something happens after it happens."
> (Richard Feynman, "The Meaning of It All," 1963).

What is he saying here, not to infer probabilities from data? Or rather to beware of over-fitting? The renowned mathematician David Donoho told me a while ago that the latter is called "optimal brain damage" by people working on neural networks. Speaking of all these great scientists, let me tell you I have a book on my shelf called "Men of Mathematics" by E. T. Bell (1965). The title is of course because of the nice alliteration.

The World Congress in Toronto was a memorable event with a wonderful scientific program, many great names walking around in person, many rising stars, many nice people. Let me thank the local chair Tom Salisbury, the scientific program chair Alison Etheridge, and everybody involved to make this congress into a success. During the congress week, the world was facing historical events, and discussions and concerns went beyond probability and statistics. There were also several administrative meetings, one of which was the General Assembly (GA) of the Bernoulli Society. The GA is the place where members can vote on important decisions (electronic voting is also possible). Let me therefore invite you to attend the GA's if you have the opportunity.

…. *Continued on page 1*

***Deadline for the next issue:* 31 March, 2017**
Send contributions to: mmbbcarvalho@gmail.com

A View from the President (continued from front cover)

The Tenth IMS/BS World Congress in Probability and Statistics will be in 2020 at Seoul National University. This promises to be an unforgettable event at a fabulous location. I am thankful to the local organisers at SNU for the warm welcome Susan Murphy and I enjoyed at a visit of the site. I know it is far in future, but if you plan to go to the WC 2020 (which I recommend) I have three suggestions. Firstly, to consider staying at a 'youth hostel' instead of a hotel. The hostels have no age limit and they are about as comfortable as most hotels here in Zürich but much cheaper. Secondly, to consider a trip to the North Korean border, for example the Mount Kumgang Tourist Region. Thirdly, to attend the GA at this congress, we plan to have food and drinks!

Many of you will be busy now with writing grants, teaching classes, supervising theses, sitting in committees, reviewing papers, correcting exams … and with your research!

But do have a look at the upcoming meetings. And remember, the next GA is in July 2017 at the 61st World Statistics Congress—ISI2017 in Marrakech!

Sara van de Geer
President of the Bernoulli Society
Zurich

News from the Bernoulli Society

10th World Congress in Probability and Statistics

As mentioned by Sara van de Geer, on *A View from the President*, the venue and the dates for the 10th IMS/BS World Congress in Probability and Statistics are now determined. It will be held in Seoul National University, in South Korea, during the period August 17– 21, 2020.

www.useoul.edu

Byeong Park
Scientific Secretary of Bernoulli Society

Call for Proposals: Lunch Roundtable Discussion Sessions, ISI WSC 2017

Following the success of Lunch Roundtable Discussion Sessions at the 2015 ISI World Statistics Congress (WSC) in Rio de Janeiro, the 2017 ISI WSC in Marrakech will also be featuring such sessions. They represent an opportunity to enjoy fellowship and conversation with colleagues about a statistical concept, method, or practice while also having lunch.

We invite you and your colleagues to submit any ideas that you feel would make for a good lunch roundtable discussion for the 2017 WSC.

Submissions will be possible from November, 15th, 2016 to January, 24th, 2017. Final decisions will be made by February, 7th, 2017. For more information, please visit the page goo.gl/8t8tnq, or contact the Chair of the LRTD Committee, Fabrizio Ruggeri, at

fabrizio@mi.imati.cnr.it

Victor Panaretos
Lausanne

Prizes, Awards, and Special Lectures

Call for Nominations for the Newbold Prize

The Newbold Prize Committee invites nominations for the Ethel Newbold Prize. The Ethel Newbold Prize for excellence in statistics is awarded every 2 years, next time in spring 2017. The name of the prize recognizes a historically important role of women in statistics. The prize itself is for excellence in statistics without reference to the gender of the recipient. The Ethel Newbold Prize is generously supported by Wiley.

Description

The Ethel Newbold Prize is to be awarded to an outstanding statistical scientist for a body of work that represents excellence in research in mathematical statistics and/or excellence in research that links developments in a substantive field to new advances in statistics.

In any year in which the award is due, the prize will not be awarded unless the set of all nominations includes candidates from both genders. The award consists of the prize amount of 2500€ together with an award certificate. For this call, the prize winner will be selected in spring 2017. The prize will be awarded at a following Bernoulli World Congress, Bernoulli-sponsored major conference, or ISI World Statistics Congress. The awardee will also be invited to present a talk at one of these conferences.

Further information about the Ethel Newbold Prize (and other prizes of the Bernoulli Society) may be found at

www.bernoulli-society.org/index.php/prizes

Submission of Nominations

Each nomination should include a letter outlining the case in support of the nominee, along with a *curriculum vitae.* Nominations as well as any inquiries about the award should be sent to Oddbjorg Wethelund, Department of Mathematics, Aarhus University, email:

oddbjorg@math.au.dk.

The deadline for accepting nominations is November 30, 2016.

About Ethel Newbold

Ethel May Newbold (1882–1933) was an English statistician and the first woman to be awarded the Guy Medal in Silver by the Royal Statistical Society, in 1928. A detailed biography of Ethel Newbold may be found in Greenwood (1933).

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Eva B. Vedel Jensen (chair)
Claudia Klüppelberg
Jon A. Wellner

The Newbold Prize Committee

KIM (Keep in Mind): ALEA, the Latin American Journal of Probability and Mathematical Statistics, publishes research articles in probability theory, stochastic processes, mathematical statistics, and their applications. It publishes also review articles of subjects which developed considerably in recent years. All articles submitted go through a rigorous refereeing process by peers and are published immediately after accepted. It is an electronic journal which provides open access to all of its content. ALEA is supported by IMPA, Instituto do Milênio, CIMAT, IMS and the Bernoulli Society, among other institutions. Visit ALEA website *http://alea.impa.br/english*

Articles and Letters

Applied Stochastic Modelling for Structured Physical Processes

Valerie Isham, Department of Statistical Science, University College London, London, UK
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Communicated by Sara van de Geer

The Bernoulli Lecture is awarded for contributions in applications in statistics or probability, and my focus is on the use of stochastic modelling. Such modelling, in which a mechanistic model is used to represent a physical process (albeit in highly idealised form) is an invaluable tool in a broad range of applications. The parameters of these models are interpretable and relate directly to physical phenomena. As well as giving insight into the process and understanding of its main drivers, the model can be used to address important issues, answering 'what if' questions, developing appropriate control strategies and determining policy. This brief account of the conference talk discusses some of the purposes of modelling and the questions that need to be asked and choices made when a model for a specific application is developed. The discussion is illustrated with examples from a variety of applications, including epidemics, rainfall and soil moisture, and wildfires.

§1. Modelling Approaches and Questions

It is often helpful to distinguish three broad classes of models: Deterministic models aim exactly to describe a physical process from fixed initial conditions with no allowance for uncertainty, e.g. a global climate model (GCM); stochastic, mechanistic models represent (albeit in highly idealised form) a physical process via an analytically tractable model, with parameters directly relating to physical phenomena, used to gain understanding of the main drivers of the process, e.g. a stochastic representation of a spatial-temporal process of rain cells (see later); statistical descriptive models represent statistical properties of data and their dependence on covariates without necessarily aiming to encapsulate the physical mechanisms involved, e.g. a thresholded Gaussian field representation of precipitation intensity with negative values interpreted as 'dry.' Fade-out of epidemics provides an example of the importance of stochasticity. Processes have often been described in stochastic terms but analysed deterministically via sets of ordinary differential equations, so that variables are densities (proportions) of e.g. infectives, in large populations, and the discreteness of counts is ignored. The pitfalls of this approach need to be appreciated; see, for example, a discussion of the role of the 'attofox' in the spread of rabies in mainland Europe in Mollison (1991). In particular, an infection never wholly dies out. In an open population (with recruitment of susceptibles), tiny amounts of residual infection regenerate to give repeated waves of infection. In contrast, with a stochastic approach, once a state is reached with only a single infective remaining, the infection may soon die out completely, and is certain to do so eventually, unless there is a continuing external source of infection.

In building a stochastic model of a physical process, there are many questions to be addressed:

- What is the purpose of modelling? Designing control strategies? Planning or prediction? What approximations of the physical process are acceptable? What are the variables of interest? What data are available for model fitting and validation?
- Is the model of the process required in space, in time, or in space-time, and in discrete or continuous spaces (using continuous spaces and integrating as necessary allows flexibility of scales)? Is a Euclidean space appropriate? In some applications, point events are located on a linear subspace of $\mathbb{R}^k$ (e.g. in Baddeley *et al.* (2016), webs of urban wall spiders are located on the mortar between the bricks). Given its directionality, it is generally preferable to keep time as a separate dimension. What are the relevant spatial and temporal scales? Is the process stationary? Is aggregation of the process over a region, giving a purely temporal or purely spatial process, sufficient?

A number of applications will be discussed, chosen to illustrate a range of possible answers to these questions, as well as the variety of applications in applied probability. Lack of space precludes inclusion of details of the theoretical developments underpinning the models, though indicative references are given.

§2. Generic Model Components

In building stochastic models of physical processes, it is helpful to know what sorts of model components have good physical properties and are mathematically tractable. In this section, a few basic building blocks that will be used in the following applications are outlined; see Cox and Isham (1980) for details.

The homogeneous Poisson process in $\mathbb{R}^k$ ($k \geq 1$) has the property of complete spatial randomness. Realisations of the process are quite irregular, typically including some quite tight clusters of points as well as substantial empty regions. It is the base against which clustering and inhibition must be judged; its clusters and empty spaces are not the result of underlying inhomogeneity or attraction/inhibition mechanisms. There are powerful theoretical reasons why the Poisson process is a good representation of many physical point processes. It is the limiting process resulting, under very general conditions, from operations on point processes of superposition, translation and thinning, and plays a role somewhat analogous to that of the normal distribution in statistics. In one dimension, the Poisson process has the Markov property. The temporal Markov assumption is a good approximation (and with no loss of generality exact given a suitable definition of the state space) for many physical spatial-temporal processes and greatly simplifies their analysis.

There are a number of extensions of the homogeneous Poisson process that are both physically plausible and mathematically straightforward:

- nonhomogeneous: the rate is a function of the underlying space or space-time (e.g. seasonality, topography);
- doubly stochastic (Cox): the rate function is random (e.g. variable weather). This process is necessarily overdispersed, which is often a feature of empirical data;
- marked: random marks (which may depend on covariates) are attached to the points;
- cluster: a marked Poisson process of (unobserved) cluster centres, with independent and identically distributed (iid) clusters of points and random cluster sizes (e.g. parent-offspring mechanism). Tractable options include:
  - in space: iid displacements about cluster centres (Neyman–Scott);
  - in time: finite Poisson process following the cluster centre (Bartlett–Lewis), to retain a temporal Markov structure;
- Self-exciting (Hawkes): each point gives rise to a further sequence of points (this is a a generalised Poisson cluster process, in which each cluster centre has a branching process of 'descendants').

§3. Temporal Epidemic Models

Epidemic models have many applications, not only in the context of human and animal infections but also including computer viruses, the spread of rumours on communications or social networks, panic selling in financial markets, viral marketing and gossip algorithms. Understanding the dynamics of an infection brings possibilities for its control, and helps to address questions such as: How can a new outbreak of an existing infection or the emergence of a new one be detected? What action is needed to prevent its spread? What contingency plans are needed for practical implementation? And, for a recurrent infection, what/when/how should a routine strategy (e.g. vaccination) be implemented?

A simple stochastic epidemic (SIR) model. In this Markov model (see e.g. Isham 2005), hosts are assumed to mix homogeneously, making potentially infectious contacts in a Poisson process with rate λ. Infective hosts recover at a per capita rate γ (or, equivalently, host infectious periods are exponentially distributed). The deterministic condition for an initial increase in infectives is that the proportion of susceptibles exceeds $\gamma/\lambda = 1/R_0$ (which necessarily requires $R_0 > 1$) where $R_0 = \lambda/\gamma$ is the reproduction ratio, which can be interpreted as the mean number infected by a single infective during their infectious period if all their contacts are with susceptibles. However, it is easily shown that the deterministic SIR model does not give the mean of the stochastic model.

For the stochastic SIR model, a branching process approximation can be used for small t to obtain a stochastic threshold theorem. In this case, starting from single infective, extinction is certain for $R_0 \le 1$ but occurs with probability $1/R_0$ when $R_0 > 1$. The link between the deterministic and stochastic approaches is that if an outbreak does take off, a Central Limit effect occurs as the population size n increases, and the SIR process approaches a Gaussian diffusion about the deterministic solution (Whittle 1957; Kurtz 1970, 1971) with much of the variation coming from that of the random time in the initial stage of the outbreak before it takes off. The means and variances of the state variables scale with n, and thus the proportions converge to the deterministic solution with probability one. An important practical consequence of these threshold results is that a particular outbreak can be controlled by increasing γ (quarantining) or decreasing λ (biosecurity measures) to bring R_0 below 1. In an open population, a vaccination strategy is to keep the proportion of susceptibles below $1/R_0$. Thus we see that a very simple bivariate model of transmission dynamics can provide important and remarkably robust practical insights.

Epidemic Processes on Networks. To escape the assumption that the host population mixes homogeneously, there are various ways to incorporate population structure. In a metapopulation, the population is stratified into a fixed number of groups where, typically, each individual can be directly infected by every other, and the reproduction ratio R_0 extends to become the spectral radius (dominant eigenvalue) of the first generation matrix (Heesterbeek 1992). In contrast, in network models, individuals can only be infected by those to whom they are directly connected by the graph. Homogeneously mixing models and most metapopulation models can be regarded as network models where the underlying graph is completely connected (in the latter case the edges are weighted). If we consider an SIR epidemic model superposed on a network (e.g. social interaction network), then we can ask what properties of the graph are most responsible for driving the transmission dynamics of the epidemic process and, specifically, how does the network structure affect thresholds for spread.

There are many possible models for the underlying network. The importance of the degree distribution in determining spread is well established and, in a configuration graph, the node degrees have an arbitrary distribution, with the 'stubs' (half edges) connected at random. The simple random graph (Erdös and Rényi 1960) is a special case where the degree distribution is Poisson. Configuration graphs are often assumed in theoretical work because the structure allows a branching process approximation for the early stages of an epidemic. In contrast, a preferential attachment graph, characterised by the presence of 'hubs' that promote spread, is a growth model where the degree distribution has a power law tail (e.g. Barabasi and Albert 1999). However, both classes of graphs are asymptotically unclustered (the proportion of triangles tends to 0) and the degrees of neighbouring nodes are asymptotically uncorrelated, while social networks exhibit both correlation and substantial clustering ('your friends are likely to be my friends').

The random geometric graph based on a

homogeneous Poisson process is an alternative model. It has Poisson degrees and is both correlated and clustered (both coefficients are fixed and easily shown to be $1 - 3\sqrt{3}/(4\pi) \simeq 0.59$). Random graphs with an arbitrary degree distribution can be obtained by rewiring a configuration graph to incorporate desired levels of clustering (Bansal *et al.* 2009) or correlation (Xulvi-Brunet and Sokolov 2004), without changing the node degrees. A further possibility is to generalise the random geometric graph while retaining at least some of its tractable analytic properties by basing the construction on an alternative point process e.g. a spatial Poisson cluster process for increased clustering, or a inhibitory process.

Empirical observations (Isham *et al.* 2011) on the threshold for major outbreak, show that for an SIR epidemic, there is much less spread with a random geometric graph (RGG) than with a simple random graph (SRG) having the same size and degree distribution (Poisson). By rewiring the SRG to introduce either correlation or clustering, it was shown that there is little effect of increasing correlation. However, increasing clustering has a marked effect in reducing transmission. For confirmation that clustering plays a major role in limiting spread see Ball *et al.* (2013) for results on a household-network model where clustering comes from completely connected households and correlation from global contacts. Other network properties such as the spectral radius are also likely to be important drivers of epidemic dynamics (Ganesh *et al.* 2005; Draief 2008).

§4. Processes on (2-dim) Euclidean Spaces

§4.1. Poisson Cluster Process Models for Rainfall

Models are needed to provide artificial (simulated) data that preserve statistical properties of real rainfall data at a range of spatial and temporal scales, for purposes including the design of flood defences and urban drainage, and of radio communications networks, for which much higher temporal resolutions are needed. Non-stationarity is an issue, especially with regard to climate change. Artificial data are needed because historical data generally lack record length, spatial and temporal resolution, and coverage.

In the 1980's, the state of the art for rainfall at a point location was a Markov model for the sequence of wet/dry days, together with independent random rain amounts on wet days (Stern and Coe 1984). However, this structure is not suitable at much finer temporal resolutions, and our solution (Rodriguez-Iturbe *et al.* 1987, 1988; Cox and Isham 1988) was to build models in continuous time and space, aggregating properties as necessary for fitting, depending on the resolution of available data, and aggregating simulated data as appropriate for applications. A Bartlett–Lewis cluster process is used, that preserves the observed hierarchical structure of rain cells clustered within storms and has interpretable parameters: 'storms' (unobserved) arrive in a temporal Poisson process and have random lifetimes, during which each storm initiates a secondary Poisson process of rain cells that have random durations and constant random intensities. Thus the times at which rain cells occur has a strong temporal Markov structure if the storm and cell lifetimes are assumed to be exponentially distributed. The instantaneous rainfall intensity is the sum of the intensities of all the active cells, which is integrated over disjoint time intervals for comparison with data. The temporal Markov structure and nice integral representation enable many properties to be found analytically and used for fitting (by a generalised method of moments, GMM).

Although the temporal model was initially devised for hourly/daily rainfall, it has been found (Kaczmarska et al. 2014) to capture subhourly as well as hourly and daily rainfall structure when fitted to 5-minute data. It has been successfully applied in many different climatological regimes worldwide, and has had substantial impact on hydrological practice and policy making. It is also possible to allow the model parameters to depend (non-parametrically) on continuously varying meteorological predictors (large-scale atmospheric variables) via local mean/linear GMM (Kaczmarska *et al.* 2015). The location-dependent predictors may be observed (historical data), or obtained from regional climate models (RCMs) to allow the incorporation of climate change scenarios. This extension of the model fitting enables the representation of interannual variation, which is impossible if fitting by only basic seasonality by using month as the sole predictor.

In spatial-temporal extensions of the temporal model (Chandler *et al.* 2007), models are constructed in continuous space as well as continuous time. Storm origins (unobserved) occur in a spatial-temporal Poisson process, and each storm cluster has a random velocity that applies to all its cells, an elliptical shape and (exponential) lifetime. Within the storm lifetime, cells occur in a Poisson process in time, spatially displaced relative to the moving storm origin with the random displacements reflecting the same elliptical shape. Rain cells are random cylinders, with randomly-scaled elliptical cross-sections, and random intensities and durations. The interior of a rain event is a superposition of such clusters, in which cells are being born and dying, and where each cluster moves with its own random velocity. The advection process by which rain events move over a catchment is modelled separately.

§4.2. Spatial-Temporal Soil Moisture Models

The rainfall models described above can be used to provide the input to stochastic models for soil moisture, which increases due to infiltration of rainfall and decreases due to evapotranspiration and leakage through the soil. This decrease can be modelled by a deterministic decay at a state-dependent rate that depends on vegetation and soil characteristics. At a point location, this model is a generalisation of a Takács model for the virtual waiting time in a queueing process, and is mathematically tractable model (Rodriguez-Iturbe 1999) enabling analytic results.

However, soil moisture has complex spatial dependencies, because of correlated rainfall input, vegetation cover and soil characteristics, and because the ground topology causes run-off from one location to affect nearby locations. There are questions about how much the physical process can reasonably be simplified, and what are the relevant spatial and temporal scales. For example, it is convenient to consider dynamics at a daily time scale so that effects of diurnal fluctuations in temperature on evapotranspiration can be ignored, and to focus on a single season. Rain cells are shortlived compared with a daily time scale, so it is possible to ignore their clustering and movement, and simply to model the daily rain amount and spatial extent. If analysis is confined to relatively small spatial scales, then feedback between soil moisture and rainfall does not need to be taken into account and supposing a flat landscape e.g. savannah, avoids run-off complications. Even greatly simplified models such as this enable interesting and useful results to be obtained; e.g. Rodriguez-Iturbe *et al.* (2006) considers the effect of heterogeneous vegetation on properties as the spatial scale varies.

§4.3. Spatial-Temporal Wildfire Models

Wildfires are a major topical concern for which stochastic spatial-temporal models are currently being developed and there are many similarities with rainfall fields. If the purpose is to provide a mechanistic description of the process (with accurate representation of properties, for possible development of control strategies, and for simulation) a Poisson basis might be suitable. Prior to starting modelling, answers are needed to the sorts of questions posed in §1:

- What is the cause of the fires to be modelled? Of most interest are random lightening strikes, and possibly random human events. Are all ignition events to be modelled or only those where burn/damage is above some threshold? How much detail is needed? How much can the physical mechanism be simplified and approximated?
- What are the variables of interest? First and foremost, these are likely to be the times and/or locations of fire occurrences, the extent of the region burnt in time and space, and some measure of economic damage.
- What are appropriate covariates? Some possibilities are temperature and other weather/climate variables, and soil moisture (which are all random and time-varying), and vegetation type and soil characteristics (which will normally be fixed).
- What are the appropriate spatial and temporal scales? Is a model in continuous space and time required: the option to integrate over space and time as necessary for fitting and applications allows flexibility of scales.
- Are there sources of nonstationarity? Are there changing practices relating to fire detection, or effects of changing land use or demography? Climate change effects might mean more frequent or larger extremes of wind speed and temperature, and the conditions supporting smouldering combustion.

If the locations are consistent with a Poisson or doubly stochastic Poisson (dsPp) process (i.e. with temporal and spatial [conditional] stochastic independence in disjoint sets), a possible underlying model for the spatial-temporal process of fire locations might be a nonhomogeneous dsPp, with a rate determined by covariates such as 'flammability' in space-time, which itself could be affected by variables such as temperature, rainfall, amount of peat or presence of eucalyptus trees. As in the rainfall example above, it would be possible to use output of weather variables from a regional climate model under climate change scenarios. Fitting the wildfire hazard function is discussed by Xu and Schoenberg (2011) and Hernandez-Magallanes (2014), while Taylor *et al.* (2013) provide an excellent review of issues surrounding both occurrences and spread, and discussion of covariates.

If we now think about how extensions of the basic doubly stochastic Poisson process can be used to model fire spread, a Poisson cluster process would be appropriate if a random mechanism generates clusters of fires while, if each fire gives rise to a further random sequence of fires, a self-exciting process would be indicated. Marks could then be attached to the space-time point locations to represent random spatial extents, temporal durations or velocities (although the latter would presumably be determined by covariates such as wind speed and flammability of vegetation); for example in Ager *et al.* (2014) the mark corresponds to fire size for fires with sizes above a threshold. Are randomly-sized discs a reasonable approximation to the burn areas? How important is directionality to the burn? Ellipses with random orientation and eccentricity—as in the rain cells—might be a better representation. A related question is whether the spread of fire around its initial location can it be regarded as instantaneous (effectively a trade-off of movement against area if time scales are not too fine) or needs to be modelled in continuous time? Perhaps some compromise is possible, whereby the duration and extent of the spread are modelled using a Poisson cluster process of overlapping elliptical 'cells'. But this is for the future.

Acknowledgements

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Making the First Step Towards Scientific Research

†A letter to my daughter, Rong-Rong Chen

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Communicated by Ed Waymire; Translated by Rong-Rong Chen

This article originates from a letter that I wrote to my daughter in 1997 when she had just passed the doctoral qualifying examination and was about to start doctoral research. In this letter, I shared my research experience in the past twenty years with her. In the same year, as the dean of the graduate school, I was invited to give a speech to the incoming graduate students, for which the letter was introduced and then modified into this current version. In subsequent years, this article has served as a main reference for educating new graduate students on how to conduct research. This article was published in Mathematical Bulletin (2002, Beijing) in Chinese as an invited article and since then it was re-published twice in Chinese by the Chinese Mathematical Society Newsletter (2009, Beijing) and Mathmedia (2013, Taipei), respectively.

§1. Selection of Research Directions and Topics

Making the right choice of research directions is of foremost importance to any researcher. Many people waste their lifetime's efforts due to the poor choice of research directions. I usually spend nearly one third to one half of total research time on investigating and making the right choices for my own and my students' research directions. A good research direction requires a solid foundation, clear background, and strong potential. It either plays an important role in its own field, has crucial connections to other fields, or has significant applications. Trendy research directions are not necessarily important; some of them may turn out to be short-lived. Research topics that were popular three years ago may run out of steam now or even have difficulty getting published. In the 1980s, there were several trendy research directions in probability theory, on which I spent several years of time. Luckily, I did not devote myself completely to those directions as they have cooled down gradually over the past years. Recalling this experience, I learned a great deal in choosing the right research directions.

One way to learn how to choose research directions is to learn from top researchers or masters. One can benefit greatly from studying the masters' works and trying to improve upon those. This not only enhances one's own capability and aptitude, but also yields a better understanding of the way that masters choose research directions. It is most valuable if one has the opportunity to study with a master teacher in person because there are many things that one cannot learn from books, but can only be acquired by attending the masters' lectures and observing on a daily basis how they conduct research. Most people rely on the guidance of teachers to launch a successful research career; it is rare that someone can be successful while being completely independent without a teacher.

Over the years, I came to three basic principles regarding the choice of research topics. First, the topic chosen must be important and worth pursuing. Second, it has to match each student's individual strength and capability. Some students are creative and full of imagination, while others tend to be more technical, hardworking, and persistent. Third, the decision should be beneficial towards the long-term goal of the research group. Realizing the great influence that the choice of research topics may have on a student's research career, I am always cautious when it comes to this matter. It often takes me about three months to reach a decision. If the decision is made by the teacher, then at the beginning a student often does not fully understand the reason behind the decision, and thus lacks the enthusiasm to tackle this problem. It often takes a long time for the student to develop a passion for it. Occasionally, I ask a student to look for and select a few topics by himself and then I will advise him to choose the right one among those, with the understanding that it is often difficult for a student at the early stage to judge the value and depth of various research topics.

§2. Boldness, Judgment, and Confidence

Judgment refers to the capability of choosing research problems, which requires not only mathematical intuition but also long-term cultivation and training. According to a Chinese ancient saying: "If you read the three hundred poems from the Tang Dynasty fluently, then you can at least recite poems if not write one." On one hand, this means that practice makes perfect and thus emphasizes on the training of fundamental skills (we will elaborate on this point later). On the other hand, it says that one's judgment will improve as one broadens his horizons and gains more experiences. One not only needs to make sound judgment about research topics, but also the feasibility to solve the problem. Boldness refers to the courage to challenge difficult problems. I often feel my own weakness in this aspect, as I have never tackled world-class long-standing open problems. Around 1977, Prof. Zhen-Ting Hou (one of my co-advisors jointly with Prof. She-Jian Yan) told me that in order to become a great mathematician, one should study Global Differential Geometry—a goal that I thought was too hard to reach at the time. To my surprise, I obtained really good results in this field in 1993. This example shows the unpredictability of success in scientific research. As I was deeply touched by the beauty of my results, I realized that one should be even bolder in scientific research. As we see, almost all answers seem easy once you find them. Simplicity is the intrinsic nature of many things, whereas we often fail to understand such nature and tend to make things overly complicated because of our subconscious fear towards a major challenge.

The well-known Chinese proverb, "Boldness of execution stems from superior skills; and superior skills stem from boldness of execution," gives a fitting description of the dialectical relation between boldness and skills. I would like to add that even if one does not possess superior skills, it is worthwhile to be bold. One of our graduate students who came from a small school did not have as strong technical skills as his fellow classmates. Although initially I was concerned about his academic prospect, up to this point he has become the best researcher among all thirty students in his class because of his boldness, perseverance, and dedication to research. As to my own experience, I did not form an indissoluble bond with mathematics overnight. At first, I studied mathematics to make up for the poor math grades that I received in primary school. Then it was to repay the sacrifice that my parents and siblings made for my education. Later it was the responsibility towards the honor of my country, especially when I was visiting abroad. All of above have strengthened my determination. After experiencing the ups and downs of many years' society's changes, I gradually understood the true values of life and the significance of striving to succeed. Even though I was conscious about honors and recognitions in my younger years, such feelings have gradually faded. After finishing my recent work on geometry, I felt somewhat relieved that my life- long pursuit had finally paid off. This is a gift from above. My feeling echoes with a famous quote by Chinese mathematician Loo-Keng Hua: "Efforts in me, evaluation in other people." As long as you have done your best, there is no need to pay much attention to other people's opinions. Sometimes no matter how good the work is, it might take a long time to get recognized.

We often reflect on how difficult it is to make it in this modern world whereas we did not feel this way when we were leading a simple life as a student. In order to survive and succeed in the fierce competition that comes with modern society, first we have to count on our capability. It requires hard work every day to cultivate and establish superior capability, like the training of athletes. Second, we need to improve our efficiency. Only a high efficiency will bring us advantages against others because there are only twenty-four hours in a day. With great ambitions, we will have extraordinary wills and determinations that shall carry us far and help us overcome mundane troubles on the way. In order to realize one's dream, it is crucial to make thorough plans because it not only provides a blueprint of the future but also motivates us to work hard every day.

§3. Foundation and Training

No matter what the research topic is, a beginner often feels difficult or unable to proceed because of the lack of necessary preparations or research experiences. The difficulties are mostly due to two reasons. First, the lack of a strong technical foundation, and second, the fear towards unfamiliar topics. For the former, the remedy is to learn the fundamentals which build the foundation. For the latter, it is often difficult for an inexperienced beginner to judge and evaluate a new topic without the guidance of a teacher. With the teacher's support, one will feel more confident to approach the new topics and eventually prevail in research. Unfortunately, for those who do not have good teachers or good environments, it will be challenging to be able to move forward, despite the difficulties.

In general, technical foundation consists of the specialty foundation, which refers to the broad knowledge of a given field, and the topics foundation, which refers to the in-depth knowledge associated with a particular research topic. It has been a long controversial question whether breadth or depth is more important. My view is that our primary emphasis should be on the depth while in the meantime we should try to increase the breadth as much as possible. In other words, it is better to achieve great depth and understanding in one particular topic before branching out. Analogous to the generalization from a point to a plane, this particular topic will serve as the starting point, a home base from which one can extend the success of a single topic to a broad spectrum of other topics. Achieving a good balance of the depth and breadth is extremely important for research productivity. Over-emphasis on the specialty foundation may have negative effect on one's research because it takes too much time from the in-depth, focused research of a particular topic. Each time we begin a new research topic, it is necessary to read a large amount of literature to build the topics foundation. However, as we work on more topics, our specialty foundation becomes strengthened. Thus, the amount of time needed to establish a strong foundation for the next topic lessens.

What a society needs the most are specialists rather than jacks-of-all-trades. The fact that human perceptions must develop from the individual to the general supports the reasoning that we must put the main emphasis on the depth. However, true depth cannot be separated from the breadth and it should be built upon breadth. As people say, to be a great poet, you have to learn things beyond poetry itself. For instance, one's experiences and character have a great influence on his scholarship. It is hard to imagine that someone who is short-sighted is capable of performing research with great depths and vision. Breadth and depth are twins and having both will enable a researcher to reach the broad and profound realm. Every profession has its own "Kung Fu" (skills acquired through rigorous training), but how can you attain it? According to the Chinese idiom, "The boxer's fist must stick to its task, and the singer's mouth no rest must ask," the answer lies in diligent thinking and diligent doing, which are virtues of any researchers. Do not underestimate the value of daily accumulations even if it is as small as a single drip of water. The difficulties in research often lie in small problems, and this is where a person with high aims but low abilities often stumbles. Whenever we encounter new research problems or listen to lectures, it is worth spending the time to think and analyze. Many lectures are highly valuable as they contain the researchers' experiences accumulated over many years. If one can seize the essence and take advantage of them in his own research, then it will be most beneficial. On the contrary, if one forgets everything after a lecture, then it becomes a waste of time. A considerable portion of our knowledge comes from attending lectures. Although it might be difficult for the young audience to follow a lecture, one should still try to understand and digest. Years of accumulation often lead to sudden insights at a later point. Having discussions with peers is another excellent way of learning. Many concepts become clear once explained by a master. Sort this one thing out and you will sort out all the rest. Otherwise, it may be very hard to grasp the essence by yourselves. This is the benefit of studying with teachers. An effective way to learn a subject is to teach it even though one may not always have such an opportunity. In this sense, teaching is a great thing even though it takes time away from research. I often say that we should approach the study of mathematics standing up rather than lying down. That means, we should study mathematics from a researcher's point of view rather than from a student's view, which tends to be on the naive side. An analogy is to compare with a group of actors discussing the art of performing a drama and audiences who are simply watching the drama. The intellectual depths of the two are vastly different.

When starting a new research topic, it is common that one does not know where to start. In my view, the best way is starting from the simplest or even trivial examples and then trying to study as many examples as possible. This way a good understanding the topic can be developed and the risk of making unfounded claims or going astray is avoided. At first, it may seem a waste of time to study simple, special examples. However, these often lead to correct, useful ideas for the general cases and thus will eventually accelerate the research pace. Several days ago, I encountered a colleague who had just completed a "beautiful theorem." Indeed, he had told me about it previously, but I was doubtful enough to construct counterexamples for him. Thus, when I saw the manuscript, within a few hours of going through the proof, I found it to be completely wrong. Unfortunately, he had already spent more than one year working on this problem. We all make mistakes and shall learn from such, but the issue here is that without a good understanding acquired through the study of examples, a great amount of time and efforts will be wasted due to unnecessary detours. I have benefitted greatly from such study, although it is impossible to elaborate here.

Sometimes, when one becomes stuck in research, it would be wise to casually explore other related fields for inspiration. If this does not help, one has no choice but to leave it alone for a while until a sudden insight comes in the future. Another approach is that if the frontal attack fails, consider attacks from the sides or sweep the periphery. Eventually, you must rely on yourself to learn and explore additional methods.

§4. Writing and Lecturing

Writing and lecturing are both arts in themselves with the purpose to convey reliable information effectively towards readers and audiences. Nowadays, as the modern publishing industry has developed rapidly (coupled with a revolutionary change in electronic communications), the proportion of good articles will become increasingly smaller and smaller. Lecturing is a main channel for promoting research results, and thus has a long-term influence on the development of one's career. The art of giving great lectures should be studied seriously by every researcher.

Let us think about how we read articles. First, we check the title to see whether it is of interest. If so, we read the abstract to see what the new results are. If those look interesting, we then read the introduction or the parts of the paper that contain the new results. Most people will stop here; only a few will proceed to study the paper in greater detail to fully understand the proof. It suggests that the number of readers of an article is determined largely, in decreasing order of importance, by the title, abstract, introduction, and proof. This is why, for the reader's benefit, we should present our main results in the beginning parts of the paper and also specify which parts of the paper require an in-depth study.

Acquiring good writing skills is of paramount importance for the development of one's career. If a reader enjoys a good article of yours, he will be interested in reading more of your work in the future. On the contrary, if someone reads a few of your articles and forms a bad impression on the quality of your work, he will probably never read your new publications again, which in no doubt will be detrimental for one's career development. Therefore, I am extremely cautious in my own writing that I edit each of my papers at least three times to ensure the best quality possible. I remember, a great man once said, "It is a crime if a person does not present a work to the society in its best form." I echo with this thought even though my own standards have not reached such height.

One's work is a reflection of character, depth of thoughts, and soundness of technical foundation. Usually, people who are careless often make small mistakes in their writing. People with broad thoughts often produce works with great breadth. People with a solid technical foundation often demonstrate strong technical skills in their work. People with in-depth thoughts often hit the nail on the head in a few of words. It is of tremendous enjoyment to read excellent works. Every honest man should respect and acknowledge existing contributions by others. Unfortunately, some people resort to forged results or even pass others' results as their own. In the past, I have encountered such situations four or five times which make me indignant. It goes without saying that I cannot disclose such details here. I strongly believe that no matter what, we must do our best to avoid this blunder and under no circumstances can we steal other peoples' results. In the meantime, we should learn how to protect ourselves. The usual practice is that after your paper has been accepted by a journal, you should share it with others immediately by distributing preprints to establish the ownership of your results within the community. Mastery of the art of teaching requires years of experiences. Teaching must adapt to audiences of various technical levels. Giving a presentation is similar, but with a denser content. If the percentage of the audience with technical levels ranging from the expert level, medium level, to a general level, is approximately 20%, 60%, and 20% respectively, then the content of the presentation should be tailored to address such diversity accordingly. The discussion above is applicable to scenarios where there are a large number of audiences. For seminars, the percentage of experts is greater and thus the lecture can be at a higher technical level. The presentation for a paper is similar to that of above, but one needs to focus on the introduction of only a small number of results. In short, the organization needs to be carefully planned out.

This is the first time that I have attempted to write down my thoughts on research in a systematic fashion, hoping that you will try to understand it thoroughly and put it into practice. It is only through repeated practice that one can truly grasp the real essence of conducting scientific research.

Obituary: Ingram Olkin

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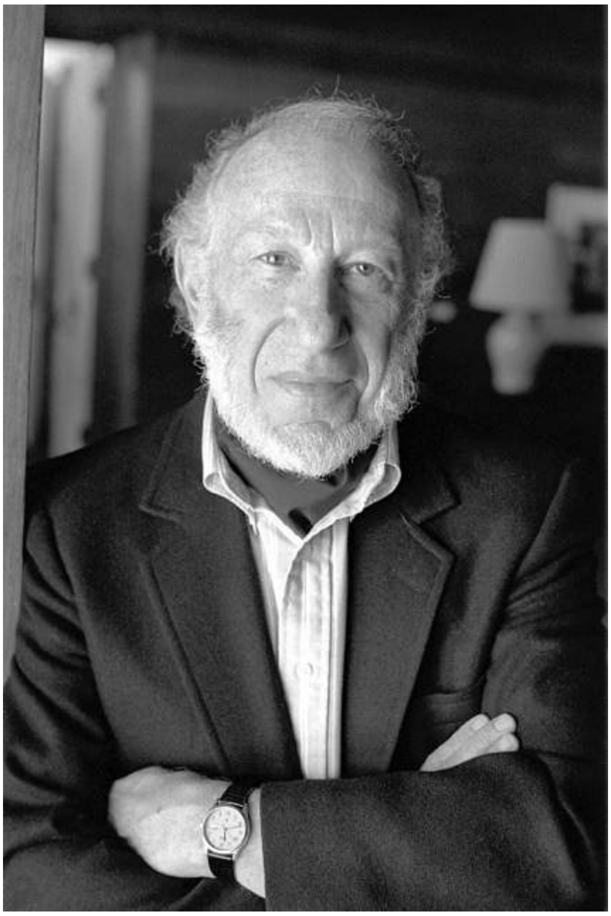

Ingram Olkin, beloved mentor and friend, passed away peacefully on April 28, 2016 at his home in Palo Alto, California. He is survived by Anita, his wife of 71 years, by his daughters Vivian, Rhoda, and Julia, and by his six grandchildren. He had long and distinguished careers in both mathematical statistics and educational statistics, which are reviewed below by us separately; however the sentiments expressed are shared by us both.

Career Origins and Mathematical Statistics (Perlman)

Ingram Olkin was born in Waterbury, Connecticut on July 23, 1924, the only child of Julius and Karola Olkin, immigrants to the U.S. from Vilnius and Warsaw respectively. In 1934 the family moved to New York, settling in the Bronx. Ingram soon immersed himself in the rich culture of New York, where his lifelong interests in the theater and music, especially opera, began. He played trombone in the orchestra at Dewitt Clinton High School and was active in the math club. He graduated in 1941 and entered CCNY shortly before the U.S. entry into World War II. Soon thereafter he joined the Meteorology Training Program of the Armed Forces, which sent him to MIT for a rigorous series of courses, including mathematics and statistics. He was inducted into the U.S. Army Air Force in February 1943 and served for three years in San Francisco until being discharged in 1946, having married Anita a year earlier. They returned to New York where he finished his B.S. in mathematics at CCNY in 1947; among his classmates were his future Stanford colleagues Herman Chernoff and Herb Solomon.

Ingram earned an M.S. in mathematical statistics at Columbia in 1948, then entered the Ph.D. program at the University of North Carolina, Chapel Hill, completing his dissertation in 1951 under the supervision of Harold Hotelling and S. N. Roy. He held professorships at Michigan State University (Mathematics, 1951–1960), the University of Minnesota (Statistics, 1960–1961), and Stanford University (Statistics and Education, 1961–2005), serving as departmental chair at Minnesota and Stanford. Despite his retirement in 2005, he remained highly active in research and lecturing until just before his death.

Ingram's contributions to multivariate analysis began at Chapel Hill where he hoped to take P. L. Hsu's course on that subject, but could not do so because Hsu had returned to China (cf. [1]). Instead, Hotelling suggested that Ingram and fellow student Walter Deemer study Hsu's notes on their own and report back to him. This resulted in Ingram's first publication while still a graduate student, the landmark 1951 Deemer–Olkin paper [2].

After that, Ingram's interests expanded to an amazingly diverse set of multivariate topics, but one common theme was the extension of univariate properties to multivariate distributions. As a visiting professor at the University of Chicago in 1955-6, Ingram collaborated with John Pratt on multivariate Chebyshev inequalities [3]. This was significant in two respects: it produced noteworthy results, and it led to Ingram's lifelong collaboration with Al Marshall. In Al's words:

> "In the spring of 1958, Ingram and John Pratt published a paper about multivariate Chebyshev inequalities in *Ann. Math. Statist.* I had results on the same subject in my thesis at the University of Washington. In the fall of 1958, I got a post-doc position at Stanford. As luck would have it, I found that Ingram was at Stanford on sabbatical, and we were assigned adjacent

offices. We both knew that there was more to be done on the subject and started to work together. That is how it started."

And so began their legendary, 58-year collaboration. First and foremost must be noted their landmark treatise on majorization [4], in which they show how many, if not most, classical inequalities, such as the arithmetic mean/geometric-mean inequality, Hadamard's inequality for the determinant of a positive definite matrix, isoperimetric inequalities for convex polygons, and entropy inequalities, all arise in the unified framework of majorization. Their statistical applications of majorization included the unbiasedness and power monotonicity of multivariate hypothesis tests, concentration inequalities for sums of independent random variables, and bounds for the probability of correct selection of the largest cell probability in a multinomial distribution or the largest population mean based on a sample from independent univariate distributions. We estimate that over three thousand papers citing the first and second editions of [4] have subsequently appeared.

Ingram and Al at work in Seattle, August 2015

A recurring theme in the multivariate extension of a univariate property is that of constructing a multivariate distribution with given marginals. Several researchers had proposed multivariate distributions with exponential marginals, but due to their interest in reliability theory—Al worked at Boeing Scientific Research Laboratories where Ingram was a consultant—they approached this problem with the goal of extending the memory-free property that is unique to the univariate exponential distribution. This resulted in the now-classic Marshall–Olkin multivariate exponential distribution (MVE) [5], which can be represented as a collection of minima of overlapping subsets of independent univariate exponential random variables. Their MVE has an important interpretation as the occurrence times of shocks to the components of a system where the shocks can affect components either individually or in groups. At first glance the MVE might appear awkward because it contains both continuous and singular parts, but as they and many others subsequently have shown, this MVE in fact allows for an elegant statistical analysis of its parameters.

After their success with the MVE distribution, Ingram and Al decided to write a book about a wider variety of multivariate extensions of univariate distributions. The first chapter of this book was to be a brief survey of univariate distributions. However, one chapter led to another, then another, resulting in their second book [6], on univariate life distributions, an invaluable encyclopedic compendium of parametric, nonparametric, and semiparametric univariate families. When this volume's influence is fully felt, we expect that it will inspire future writers to bring the intended multivariate volume to fruition.

One of Ingram's favorite mathematical topics was the solution of functional equations. He applied this with gusto to many problems on the characterization of distributions, including notable papers with Al Marshall [5,7], S. G. Ghurye [8], and Herman Rubin [9]. The latter paper, written in 1962, presented a multivariate extension of the univariate result of Lukacs that if S and T are independent positive random variables with the same scale parameter and if $B=S/(S+T)$ [or $F=S/T$] is independent of $S+T$, then S and T each must have gamma distributions. By solving an intricate system of functional equations, now known as the Olkin–Baker functional equation, Olkin and Rubin showed that the matrix beta version (using B) of this result extends to independent Wishart random matrices S and T, but that, surprisingly, the F version fails. Fifty years later, Ingram was delighted to see a resurgence of interest in this result, which has been extended to random positive definite matrices with generalized Wishart and Riesz distributions on symmetric cones (Jordan algebras) (e.g. [10]) and homogeneous cones.

Ingram was as dedicated to the service of the statistical profession as he was to research and teaching. He was highly active in an unbounded number of scientific societies, notable among these the Institute of Mathematical Statistics (IMS), whose Presidency he held in 1984. He was Editor of *The Annals of Mathematical Statistics* in 1971–2 and was instrumental in its split into *Annals of Statistics* and *Annals of Probability,* serving as the founding editor of *AS* in 1972–4. He was equally instrumental in the founding of *Statistical Science* in 1984. In 1990 he strongly advocated for the creation of the National Institute of Statistical Science at the Research Triangle. He served on the Scientific Advisory Panel of the National Science Foundation and on the Committee on National Statistics of the National Research Council. He received numerous awards including Fulbright, Guggenheim, and von Humboldt Fellowships, the Wilks Medal and Founders Award from the American Statistical Association, and the COPSS Fisher Lecturership. In 2005 he was elected to the National Academy of Education. He was a tireless international ambassador for Statistics, teaching and lecturing on five continents.

Outside the office, Ingram was an avid swimmer, frequent hiker, and intensely competitive tennis player (some would say 'cut-throat'). His love for opera and good food led him on many adventures, especially abroad, including a memorable cross-border culinary foray from Oberwolfach to Strasbourg and (eventually) back. I have a treasured collection of napkins, on the backs of which I transcribed many of the jokes that he told in the wee hours in hotel bars after conference banquets.

Ingram supervised 35 PhD students in Statistics and Education. He cherished every one of them, but among those he knew longest were Jim Press, Leon Gleser, Allan Sampson, and Barry Arnold. All will attest to the inspiration of his contagious enthusiasm for research and his concern for their continuing success. He served them not only as dedicated academic advisor, mentor, and research collaborator, but also as travel advisor, relationship counselor, and tax consultant, always accompanied by his incomparable sense of humor. A prime example is *Olkin's Law of Not-too-Large Numbers:* "The optimal distance to live from your in-laws is 650 miles; any closer and they will visit too often, any farther and they will stay too long." Ingram, you will always be close to our hearts.

Educational Statistics and Meta-analysis (Hedges)

Ingram had a deep interest in education and a joint appointment with the School of Education at Stanford. Because of that, he had many friends in education and was a major figure in the education research community. For example, in 1976 he helped found the *Journal of Educational Statistics* (now the *Journal of Educational and Behavioral Statistics*) as a joint effort of the American Statistical Association and the American Educational Research Association. When I was a young graduate student, the term meta-analysis had just been invented by an educational psychologist, who was promoting the idea of using statistical methods to "combine evidence" from many studies to draw general conclusions. This idea had gotten a lot of attention in education and psychology, but was controversial. One of the reasons was that the statistical rationale was more than just weak—it was nonexistent. Many statisticians at the time thought the whole idea was misguided. Ingram recognized that there might be interesting statistical problems in the meta-analysis so he was drawn to the area.

In fact, Ingram had already thought about some related problems. He had written a short paper entitled "Do positive correlations yield positive sample correlation coefficients?" It appeared as a technical report, but was never published. It considered the question of how likely it was for a sample correlation to be positive as a function of the actual correlation and the sample size. He also pointed out that the fraction of observed sample correlations that were positive could be used to estimate the underlying correlation and showed how to obtain point and interval estimates.

That led to Ingram's first published paper on meta-analysis [12] (with me). In it we extended the ideas in Ingram's technical report, introduced some additional estimators, and proved some results about the properties of naïve uses of the proportion of positive effect sizes to make decisions about the underlying effect size parameter. The later was important because there was a surprisingly widespread practice of evaluating a treatment using only the proportion statistically significant treatment effects among of studies of that treatment. This paper showed that such a practice had terrible decision theoretic properties.

Ingram contributed in a major way to meta-analysis in the social sciences by helping to clarify inference for standardized mean differences. A key problem in meta-analysis of research in education and psychology is that outcomes in different studies are measured on different scales of measurement. The outcome construct is typically a mental measurement of some kind (academic achievement, IQ, anxiety, etc.) and different studies may use outcome measures that were measures of the same concept, but the numbers were not directly comparable. Gene Glass identified that problem and proposed the standardized mean difference as a way to put the measurements "on the same scale." This proposition, as Glass articulated it, seemed pretty dubious to many statisticians at the time, and meta-analysis was seen as voodoo statistics by more than a few of them.

Ingram knew quite a bit about psychometrics and could see how arguments about scale fit into psychometric theory. He had also done some work on estimating scales of measurement from multiple samples with a common structural model, so the idea of combining estimates from data with different scales of measurement was not completely foreign to him.

Once we conceptualized the idea of meta-analysis as combined estimation of a structural parameter (the standardized mean difference) from experiments using different scales of measurement, Ingram was sold on meta-analysis as an idea that could lead to useful statistical methods. Ingram was constantly looking for statistical problems that he could solve. In the early 1980s he helped develop analogues to the analysis of variance and regression analysis for meta-analysis and produced papers extending meta-analytic methods for correlation coefficients, nonparametric measures of effect sizes, clustering methods for effect sizes, and a few other things. The biggest (meaning longest) contribution was our 1985 book on meta-analysis [13]. Ingram loved to collaborate and I think nearly all of his meta-analytic work has been collaborative. I collaborated with him a great deal in the 1980s and 1990s, and continued until the last year of his life. Ingram published what may be his last paper on meta-analysis [14] (with me) this year. It concerns unbiased estimation of the proportion of treatment group members whose scores exceed the mean of the control group. He also collaborated with many younger scholars who benefitted greatly from those collaborations. I know that I enjoyed our collaboration both intellectually and personally.

One of Ingram's most important contributions to the area of meta-analysis was lending his prestige as a distinguished mathematical statistician to the area when it was young and disreputable. Ingram did more to help the reputation of meta-analysis than just working in the area. He used his political skill and contacts to promote it.

Ingram also used his contacts in the scholarly world to promote meta-analysis with journal editors and professional organizations (particularly the American Statistical Association and the American Educational Research Association). In the 1980s, Ingram spent a great deal of time conducting professional development training sessions on meta-analysis.

I would be remiss if I didn't mention that Ingram was an incredible mentor, not just to me, and not just to his students, but to anyone whom he could help. He thought it was his responsibility to help young scholars reach their potential and he did everything he could to advance their careers. That included teaching students how to recognize a research problem, how to give talks, and how to publish. It also included introducing young scholars to important people (and Ingram knew *every* important person in statistics) and showing them off as his protégées. As all of Ingram's students can attest, his mentorship did not end with graduation. He continued to be in your life and give you advice (whether you wanted it or not).

Perhaps because he had three daughters, Ingram was particularly concerned with advancing the careers of women. He had many women students and his influence reached beyond his students. To this day he is the only man to win the Elizabeth Scott Award for Contributions to the Advancement of Women in Statistics given by the Council of Presidents of Statistical Societies.

I have to add that Ingram was an exemplary citizen of the scientific community. He believed in participating in all the ways that are necessary to make scientific communities work. He was always part of the 10 percent of the people who do 90 percent of the work.

Ingram's energy, good humor, and good example will be greatly missed by everyone who knew him.

Acknowledgments

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Past Conferences, Meetings and Workshops

9th World Congress in Probability and Statistics: July 11–15, 2016; Toronto, Canada

The 9th World Congress in Probability and Statistics was held July 11–15, 2016 in Toronto. The World Congress is held every four years, and is sponsored jointly by the *Bernoulli Society for Probability and Mathematical Statistics* and the *Institute of Mathematical Statistics*. Previous congresses have been held in Istanbul (2012), Singapore (2008), Barcelona (2004), Guanajuato (2000), Vienna (1996), Chapel Hill (1994), Uppsala (1990), and Tashkent (1986). This year's was hosted by the *Fields Institute*, on the campus of the University of Toronto.

The Toronto Congress attracted over 400 participants, and featured 18 plenary talks, 40 invited sessions, 4 contributed sessions, and 41 sessions of contributed talks, as well as posters. There were about 280 talks in total, which spanned a broad range of topics from probability, finance, statistics, and biostatistics. With 4 plenary talks per day, plus morning and afternoon rounds of 10 simultaneous sessions, congress participants had a wide variety of options. Sara van de Geer (ETH Zürich) gave a series of three Wald lectures on high-dimensional statistics. Bin Yu (UCB) delivered the Rietz lecture, on *Theory to gain insight and inform practice*; Judith Rousseau (Paris Dauphine) the Ethel Newbold prize lecture, titled *On the Bayesian measures of uncertainty in infinite dimensional models*; Byeong Park (Seoul National Univ.) the Laplace lecture, on *In-sample density forecasting*; David Brillinger (UCB) the Tukey lecture, titled *People are different*; Valerie Isham (Univ. College London) the Bernoulli lecture, on *Applied stochastic modelling for structured physical processes*; Servet Martinez (Universidad de Chile) the Lévy lecture, on *Quasi-stationarity in Markov chains and population dynamics*; Scott Sheffield (MIT) the Doob lecture, on *Random surfaces and gauge theory*; Ofer Zeitouni (Weizmann Institute) the Schramm lecture, on *Extremes in logarithmically correlated fields*; Ruth Williams (UCSD) the Kolmogorov lecture, on *Reflected diffusions and (bio)chemical reaction networks*; and a further plenary talk was given by Fields medalist Martin Hairer (Warwick), titled *On the algebraic structure of renormalisation*. IMS Medallion lectures were delivered by Christina Goldschmidt (Oxford), on *Scaling limits of critical random trees and graphs*; Arnaud Doucet (Oxford), titled *On pseudo-marginal methods for Bayesian inference in latent variable models*; Vanessa Didelez (Bremen), on *Causal reasoning for events in continuous time*; Pierre del Moral (UNSW), on *An introduction to mean field particle methods*; and Frank den Hollander (Leiden), on *Metastability for interacting particle systems*. Details may be found at

www.fields.utoronto.ca/programs/scientific/16-17/WC2016/index.html

There were many memorable talks, and participants remarked on the high quality of the science and the stimulating discussions they encountered (facilitated by the excellent refreshment during the coffee breaks). The World Congress is unusual, in that it brings together both probabilists and statisticians, and gives each group an opportunity to learn what is current in the other's discipline.

The Fields Institute staff and student volunteers made the meeting run very smoothly, and the city of Toronto cooperated with dry warm weather. Accommodations proved a bit of a challenge, as a Microsoft meeting had brought 15,000 people to Toronto at the same time, so between the two meetings the city was virtually sold out of hotel rooms on certain days. While most of the meeting was held at the University of Toronto, an opening reception on the Monday filled two floors of the Fields Institute. This was hosted by the IMS, and was preceded by the IMS awards ceremony and Presidential address. The Bernoulli Society had sponsored a pre-congress meeting for new researchers (held at Fields and organized by Andreas Kyprianou), and during the Congress week it also hosted a reception for new researchers, at a pub near the meeting site. Wednesday evening saw the Congress banquet, which took place while cruising around Toronto harbour and islands aboard the ship Kajama. The weather was beautiful, and participants were rewarded with good company and beautiful views of the city.

Alison Etheridge
Oxford—Chair, Scientific Program Committee

Tom Salisbury
York—Chair, Local Arrangements Committee

New Researcher's Reception @ 9th World Congress in Probability and Statistics

On the second day of the World Congress in Probability and Statistics in Toronto, the Bernoulli Society hosted a New Researcher's Reception at the Prenup Pub. The evening began with a warm opening address by the President Professor Sara van de Geer who enthusiastically presented us the many active fields of interest of the Bernoulli Society. Then, the almost 50 young researchers in Probability and Statistics enjoyed different sorts of (thankfully cold) beer from all over the world (ranging from German, to Dutch, and even to Chinese beers) and typical local dishes. During this hot Canadian summer evening we had the unique opportunity to meet colleagues and make new friends from various probabilistic and statistical fields and countries. For sure, these encounters have enriched all our personal as well as our professional future development. The success of this year's reception makes me confident that the New Researcher's Reception will become a stable tradition during the World Bernoulli Conferences.

Andreas Elsener
Zurich

Workshop on Fractality and Fractionality: 17–20 May, 2016; Leiden, The Netherlands

At the Lorentz Center from May 17 until May 20, 2016, the Workshop on Fractality and Fractionality has been held. The number of participants, about 60, reached the maximum capacity of the Lorentz Center. The organization was forced to turn down many more applications for attendance. The organization was very pleased with the large interest from participants abroad, almost all, that confirmed the intended international character of the workshop. Another positive element was the large participation of young researchers.

The scientific program consisted of 29 plenary lectures (many of them by invited speakers) and 6 discussion sessions (pairwise in parallel) devoted to selected research topics. Next to the lectures and organized discussion sessions, the program offered ample time for informal discussions, also stimulated by the organizers through long lunch breaks, as well as shorter breaks between the lectures. These discussions also continued after the scheduled lectures, occasionally until after midnight in small groups. Certainly the excellent facilities of the Lorentz Center played an important role in the success of the workshop.

The workshop was concluded by a large 'round table' discussion session. Here a number of open problems to work on in the future have been posed. Participants have been invited to submit more open problems to the journal *Modern Stochastics: Theory and Applications* with co-editors-in-chief K. Kubilius (participant of the workshop) and Yu. Mishura (organizer of the workshop). The same journal will also publish selected papers with a stochastic content related to the lectures in a special issue. Selected unpublished papers with an analytic content will be invited for publication in the journal *Fractional Calculus and Applied Analysis* (editor-in-chief V. Kiryakova, participant of the workshop).

The organizers have received many very positive reactions by the participants during the workshop. The high scientific content of the program was praised, as well as the facilities of the Lorentz Center and the very helpful assistance by the staff.

For more details about the workshop, please visit

http://tinyurl.com/pmpy3oy

Peter Spreij
Amsterdam

Frontier Probability Days 2016: May 9–11, 2016; Salt Lake City, Utah, USA

The photo collage is courtesy of Mr. Richard Lee, Corvallis, OR.

The fifth biannual Frontier Probability Days (FPD) regional conference was held on the campus of the University of Utah in Salt Lake City, May 9–11, 2016, with financial support from the National Science Foundation, the University of Utah Department of Mathematics, and nominal sponsorship of the Bernoulli Society and Institute of Mathematical Statistics. This year's conference featured eight invited plenary speakers, as well as twenty-two short talks in two parallel sessions. The topics covered a broad range of contemporary research in probability theory and its applications, including applications to statistics, biology, computation, and dynamical systems. The detailed schedule and abstracts can be found on the conference web page

www.math.utah.edu/~firas/FPD16

Some special attributes of this conference include the attention to diversity that is given to planning. There were fifty-three registered participants with a healthy representation by young researchers. Two of the eight plenary speakers were women. In addition, a special feature of the presentations includes one plenary speaker from outside the usual "card carrying'' community of probabilists, but known for their work involving the use of probability theory and methods in scientific applications. This year that speaker was Eric Vanden-Eijnden from New York University who lectured on an applications of large deviation theory to problems from material sciences and fluid dynamics.

Professor Mu-Fa Chen, Beijing Normal University, was also among the plenary speakers and delivered a lecture under the tantalizing title: The charming first nontrivial eigenpair.

In addition, an interview was conducted with Professor Chen on his personal journey as a mathematician in China. Professor Chen shared insightful perspectives from his own career that will be prepared for eventual publication by IMS. The remarkable letter by Professor Chen to his daughter at the start of her graduate education, Making the First Step Towards Scientific Research, is published in this issue of Bernoulli News for the benefit of all.

Tom Alberts, Davar Khoshnevisan & Firas Rassoul-Agha
Salt Lake City

Sunder Sethuraman
Tucson

Ed Waymire
Corvallis

The First Melbourne-Monash Probability Day: June 2, 2016; Melbourne, Australia

The inaugural First Melbourne-Monash Probability Day was held at the School of Mathematics and Statistics of the University of Melbourne on 2 June 2016. The conference was organised by the probabilistic community from the two leading Victorian universities, the University of Melbourne and Monash University.

The meeting was a continuation of a successful series of half-day mini-conferences on Probability Theory and its Applications that had been run by the same group since 2010, the two institutions hosting the events in alternating order. There were seven invited speakers at the conference: Nathan Ross, Daniel Dufresne, Kostya Borovkov from the University of Melbourne; Greg Markowsky, Jie Yen Fan and Andrea Collevecchio from Monash University; and Laurence Field of the École Polytechnique Fédérale de Lausanne. They presented 40-minute talks to an audience of about thirty participants on a variety of topics from probability theory, ranging from urn models, refinements of classical limit theorems to SLE and conformally invariant loop measures. Further information about the event can be found at the newly created Probability Victoria website at

https://probvic.wordpress.com/conferences

(still under construction).

Konstantin Borovkov
Melbourne

Forthcoming Conferences, Meetings and Workshops, and Calendar of Events

Sponsored and Co-Sponsored by Bernoulli Society for Mathematical Statistics and Probability

XIV CLAPEM: December 5–9, 2016; San José, Costa Rica

The Latin American Congress of Probability and Mathematical Statistics is the main event in probability and statistics in the region, having been held roughly every two or three years for almost 30 years. It is organized under the auspices of the Bernoulli Society for Mathematical Statistics and Probability and the Latin-American Society on Probability and

Mathematical Statistics. The series of CLAPEMs has greatly contributed to the development of probability and statistics in Latin America by promoting regional cooperation, increasing the scholarly level of the research work in the region, facilitating the collaboration between Latin American researchers and colleagues from the rest of the world.

Invited speakers include: Graciela Boente, Alexei Borodin, Pietro Caputo, Rick Durrett, Onésimo Hernández, Jean-Michel Loubes, Eric Moulines, Susan Murphy, David Nualart, Gavin Shaddick, Barry Simon.

Further details on the meeting can be found at:

http://goo.gl/5tI90L

Leonardo T. Rolla
Bernoulli e-Briefs Editor
Buenos Aires

PARTY 2017: January 8–13, 2017; Ascona, Switzerland

PARTY (Perspectives on Actuarial Risks in Talks of Young Researchers) 2017 will take place in Ascona, Switzerland. This international Winter School is targeted to young researchers working on current actuarial science topics. It focuses on two main areas of research of today's insurance risk: Ageing & Risk Management.

Keynote speakers include: Aspasia Angelakopoulou, Madhavi Bajekal, Barbara D'Ambrogi-Ola, Alfredo D. Egídio dos Reis, Nicole El Karoui, Paul Embrechts, Manuel Morales, Daria Ossipova, Andrew D. Smith.

Further details on the meeting can be found at:

http://goo.gl/Vz23bS

Leonardo T. Rolla
Bernoulli e-Briefs Editor
Buenos Aires

European Meeting of Statisticians: July 24–28, 2017; Helsinki, Finland

The European Meeting of Statisticians (EMS), sponsored by the European Regional Committee of the Bernoulli Society, is the main conference in statistics and probability in Europe. EMS is a conference where statisticians of all ages and from all regions meet to exchange ideas and talk about the newest developments on the broad field of statistics and probability theory.

- Opening: Martin Wainwright. Plenary speakers: John Aston, Gerda Claeskens, Alison Etheridge, Alexander Holevo, Hannu Oja. Forum: Mark Girolami.
- Closing: Yann LeCun.

Deadline for contributed paper session proposal: December 31.

Further details on the meeting can be found at:

https://goo.gl/TH4c2K

Leonardo T. Rolla
Bernoulli e-Briefs Editor
Buenos Aires

20th EYSM: August 14–18, 2017; Uppsala, Sweden

The European Young Statisticians Meeting (EYSM) is arranged every two years under the auspices of the Bernoulli Society. The idea of the meeting is to provide young researchers an introduction to the international scene within the broad subject area—from pure probability theory to applied statistics. Participation is by invitation only

Further details on the meeting can be found at:

https://goo.gl/Gmj0Nh

Leonardo T. Rolla
Bernoulli e-Briefs Editor
Buenos Aires

XXXIV International Seminar on Stability Problems for Stochastic Models: 25–29 August, 2017; Debrecen, Hungary

The XXXIV International Seminar on Stability Problems for Stochastic Models will be held during the period 25–29 August, 2017 in Debrecen, Hungary, under the auspices of the University of Debrecen, Lomonosov Moscow State University, and the Institute of Informatics Problems of the Russian Academy of Sciences. This conference has a long tradition, and it was founded by Vladimir Zolotarev in the 1970's. The previous Seminar organized in Hungary by the University of Debrecen (Eger, 28 January–3 February, 2001) was also a Bernoulli-sponsored event.

The main Sessions are on: Limit Theorems and Stability Problems; Stochastic Processes; Statistics of Time Series and Stochastic Processes; Finance, Insurance, Risk; Spatial Statistics; Applied Statistics and Data Analysis; Stochastic Dynamics; Random Graphs; Queuing Theory and Modeling Information Systems; Probability Distributions; Discrete Probability Models; Nonparametric Statistics; Statistical Learning.

For further information, please visit the website:

https://arato.inf.unideb.hu/isspsm2017

Registration Fee Discount for Bernoulli members:

Regular (€): 150 ↦ 135; 170 ↦150, 190 ↦ 170;
Student (€): 100 ↦ 90, 110 ↦ 100, 120 ↦ 110.

Sándor Baran
Debrecen

Other Events

EVA 2017: June 26–30, 2017; Delft, The Netherlands

EVA 2017—the 10th International Conference on Extreme Value Analysis—will take place at Delft University of Technology, The Netherlands.

It will schedule presentations on all Probabilistic and Statistical aspects of Extreme Value Analysis and applications in Climate and Atmospheric Science, Industrial Risks, Geosciences, Hydrology, Finance, Economics and Insurance, Biosciences, Physics, and Telecommunications and Stochastic Networks. All students, researchers, practitioners, and scientists with interests in statistics of extremes are welcome.

More details of the conference can be found at:

www.eva2017.nl

John Einmahl
Tilburg

Calendar of Events

This calendar lists all meetings that have been announced in this and previous issues of Bernoulli News together with forthcoming meetings organized under the auspices of the Bernoulli society or one of its Regional Committees (marked by).

A more comprehensive calendar of events is available on the ISI Websites

www.bernoulli-society.org/index.php/meetings

www.isi-web.org/index.php/activities/calendar

November 2016

- November 29–December 4, 2016, *21st International Congress on Modelling and Simulation*; Queensland, Australia.

December 2016

- December 5–9, 2016, *XIV Latin American Congress of Probability and Mathematical Statistics*; San José, Costa Rica.
- December 5–9, 2016, *School on Information and Randomness*; Santiago, Chile.
- December 17–19, 2016, *9th Conference of the Asian Regional Section of the IASC*; Singapore.

February 2017

- February 15–17, 2017, Workshop on Risk Quantification and Extreme Values in Applications; Lausanne, Switzerland.

June 2017

- June 15–17, 2017, *4th International Workshop on Functional and Operatorial Statistics*; Coruña, Spain.

July 2017

- July 16–21, 2017, *61st World Statistics Congress*; Marrakesh, Morocco.
- July 24–28, *39th Conference on Stochastic Processes and their Applications (SPA)*; Moscow, Russia.
- July 24–28, 2017, *31st European Meeting of Statisticians*; Helsinki, Finland.

August 2017

- August 14–18, 2017, *20th European Young Statisticians Meeting*; Uppsala, Sweden.
- August 25–29, 2017, *XXXIV International Seminar on Stability Problems for Stochastic Models*; Debrecen, Hungary.

October 2017

- October 1–6, 2017, *High Dimensional Statistics, Theory and Practice*; Fréjus, France.

Quote of the Issue: *My feeling echoes with a famous quote by Chinese mathematician Loo-Keng Hua: "Efforts in me, evaluation in other people."*

Mu-Fa Chen

Amendment to previous issue: In the obituary for Peter Hall it was erroneously stated that his wife Jeannie Hall served as Cabinet Secretary in the Australian government. Instead, she held the following positions: Deputy Official Secretary to the Governor-General of Australia; Parliamentary Liaison Officer for the House of Representatives of the Parliament of Australia; Senior Adviser of the Cabinet Secretariat in the Department of the Prime Minister and Cabinet.

Hans Müller, Davis

Recent Issues of Official Publications

Sponsored by Bernoulli Society for Mathematical Statistics and Probability

Bernoulli Vol. 23, No. 1: Feb. 2017

Editor-in-Chief: H. Dette

http://projecteuclid.org/current/euclid.bj

Stochastic Processes and Their Applications Vol. 126, No. 12: Dec. 2016

Editor-in-Chief: H. Dehling

http://www.sciencedirect.com/science/journal/03044149

Bernoulli Society Bulletin e-Briefs Issue 27: Nov. 2016

Editor-in-Chief: L. T. Rolla

http://goo.gl/G9AOgl

Co-Sponsored by Bernoulli Society for Mathematical Statistics and Probability

Have a look at *http://goo.gl/7EP2cZ* for the latest articles in *Electronic Communications in Probability*, *Electronic Journal of Probability*, *Electronic Journal of Statistics*, *Probability Surveys* and *Statistics Surveys*, as well as *International Statistical Review*.

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