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Stat Trek

An interview with Christian Genest

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Christian Genest is Professor and Canada Research Chair in Stochastic Dependence Modeling at McGill University, Montréal, Canada. He studied mathematics and statistics at the Université du Québec à Chicoutimi (BSpSc, 1974), the Université de Montréal (MSc, 1978), and The University of British Columbia (PhD, 1983). Before joining McGill in 2010, he held academic posts at Carnegie Mellon University (1983–84), the University of Waterloo (1984–87), and Université Laval (1987–2010). Over the years, he also held visiting positions in Belgium, France, Germany, and Switzerland. Christian's primary research focus lies in multivariate analysis, nonparametric statistics, and extreme-value theory. He also collaborates regularly with researchers in insurance, finance, and hydrology. He has published extensively and earned various distinctions for his seminal and widely cited work in dependence modeling. In particular, he received the Statistical Society of Canada Gold Medal for Research in 2011 and was elected a Fellow of the Royal Society of Canada in 2015. He has also served the profession in various capacities, e.g., as Director of the Institut des sciences mathématiques du Québec, President of the Statistical Society of Canada, and Editor-in-Chief of *The Canadian Journal of Statistics* (1998–2000). He is the current Editor-in-Chief of the *Journal of Multivariate Analysis*.

Dependence Modeling's third interview features Christian Genest, a Canadian statistician who has long been and remains a major developer and promoter of copula-based dependence modeling. In addition to describing his career path and his contributions to statistical methodology, he gives us a glimpse of the large number of ways in which he has served the scientific community over the past 30 years. He is setting a good example which we hope many colleagues, young and old, will follow.

1 Christian Genest and his contributions to research

How did you develop your interest for science? Was mathematics a natural choice for you?

I grew up in the 1960s, which was a decade of revolution and change in society around the world. It was easy to develop a passion for science then. Space exploration caught the imagination and through seemingly incessant medical and technological advances, our living conditions were improving by leaps and bounds. The benefits could easily be felt in my home town of Chicoutimi, located in a splendid but somewhat isolated part of French Canada. In the midst of Québec's "Quiet Revolution," and with the rapid decline in the influence of the Catholic Church in society, science was heralded as a source of economic prosperity and a beacon of enlightenment. Television was also a major agent of social change at the time; it opened our windows to the world, and many TV series promoted the virtues of science. One of my great heroes was fictional character Mr. Spock, as portrayed by Leonard Nimoy in the original *Star Trek* series.

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My mother was a music teacher and my father operated and owned a variety of small businesses during his working life. My parents valued education greatly and fostered their children's intellectual and artistic talents. I was the oldest of four and my thirst for knowledge was unquenchable. I was a very studious boy with a knack for numbers and an interest in languages, history, and geography. I loved mathematical puzzles and came to appreciate the importance and value of data when in my early teens, I acquired a play-by-play baseball board game. Together with a friend, I spent a whole summer rolling dice and keeping statistics for a fictitious league whose players we had named after our high school teachers. To help me with strategic decision-making, I came up with a player rating system that I had the impudence to submit to Radio-Canada sports journalist Guy Ferron. I was over the moon when he mentioned my work during the TV broadcast of a Montréal Expos Major League Baseball game.

In those days, there were few enriched school programs or extra-curricular activities, so grade skipping was the favored way of keeping gifted learners stimulated. As a result, I ended up entering college at age 16 and having to select a university program very soon thereafter. Lacking the maturity required to make an informed choice of career, I thought it safe to go into mathematics as it was hailed as the warp and woof of science. Statistics was not an option then, nor was I aware of its existence as a science.

Who influenced or inspired you in a significant way as you were growing up?

Education is a multi-faceted, life-long process, so any attempt to single out individual sources of inspiration seems rather invidious. For my early upbringing, I clearly owe a large debt of gratitude to my parents and immediate family. I was also fortunate to find many competent, dedicated teachers on my path, and one particularly inspiring priest, Paul Tremblay, who had received higher education in Rome before serving in my parish, and who later became Deputy Minister of Education.

I attended college in my home town. The Université du Québec à Chicoutimi (UQAC) had opened only five years earlier and many of its professors were still working on their theses or had just completed their degrees. They shared with us their passion for discovery and the beauty of mathematics. Above all, they formed an intellectual community and I wanted to be part of it. I was a hardworking, dedicated student and it came as a pleasant surprise when the Department Chair asked me to teach an introductory statistics summer course immediately after my graduation in May 1977. I really enjoyed the experience and used the money to make my first trip to Europe once the course was over. Although my family is deeply rooted in Canada, my education was Eurocentric. Visiting Paris, France, Germany, and Italy was a thrilling experience. I had read so much about European history, culture, architecture, and watched so many films portraying it that being there suddenly felt like "being in the movie" at last.

The Université de Montréal was recommended to me for graduate studies and thanks to a generous Canadian government fellowship, I could afford it. My thesis had to do with forcing, a technique designed by Paul Cohen for proving consistency and independence results in set theory; see, e.g., [45]. I completed the degree in just over a year but in the process, I became disenchanted with pure mathematics. I wanted to work in an area having more concrete applications for society and given my abilities, statistics seemed like the natural choice. Encouraged by my experience at UQAC, I timidly started thinking of an academic career, with the opportunities for travel that I hoped would come with it. It also dawned on me that a greater command of English would be critical for that purpose. So I enrolled at UBC, where I happen to have shared an office with Harry Joe for a few weeks before he went to Florida for his PhD. Vancouver is a lovely city and I lived there for five wonderful years but I had a rough time at first: I knew more Latin and German than English at the time! French is the only language I could speak fluently.

What was your statistical training like? Die Gretchenfrage: Do you consider yourself a frequentist or a Bayesian?

Although I had acquired some basic knowledge of statistics in Chicoutimi (in particular through frantic self-study in preparation for my summer course), it is at UBC that I learned the trade in earnest. The core curriculum was based on Tom Ferguson's famous textbook, which presents a decision-theoretic approach to statistics [12]. Much later, I had the privilege to coauthor two papers with him, e.g., [13]. My advisor, Jim Zidek, was (and remains) a Bayesian. When my mother heard that I would be investigating "méthodes de Bayes," she understood "baise" (French for getting laid) and was horrified!

My thesis — and much of my work in the subsequent decade — revolved around the combination and use of expert opinions expressed in probabilistic terms. Statistical methods for eliciting and reconciling expert judgments are very popular and useful for rational decision making in the face of uncertainty when data are scarce. I must also confess that this was an ideal topic, given my limited data-analytical skills at the time. Bayes' rule and functional equation theory were my primary tools. However, it is in Pittsburgh that I truly embraced the Bayesian faith. The Statistics Department at Carnegie Mellon University (CMU) was rabidly Bayesian. My postdoctoral advisor, Morrie De Groot, was a wonderful mentor; his views on the subject influenced me greatly, and this has been reflected in my teaching ever since. Mind you, this does not prevent me from being pragmatic when it comes to data analysis. While at CMU, I also had a very intense and successful collaboration with Mark Schervish; see, e.g., [30, 40].

In terms of prospect theory (see, e.g., [44]), what irrational behavior, if any, do you observe in your career and how does it reveal itself in daily life?

As a good Bayesian, of course, I strive to make well informed and rational decisions at all times (remember Mr. Spock). In day-to-day life, however, we sometimes face imperatives and have to make do with incomplete or unreliable data. At other times, we are taken over by emotions — such as anger or love — and these feelings are so strong that they obscure the facts or cloud our judgment. When that happens, we can only rely on our intuition and pray our lucky stars that things turn out for the best. With hindsight, our choices of the past sometimes seem suboptimal, even when they were well grounded. But we cannot foresee everything and besides, our utility function often changes with time.

We should not be despondent, however, because inconsistencies are part of nature. This is beautifully illustrated by Efron's dice A, B, C, D which are such that the odds of A winning against B, B against C, C against D, and D against A are all 2:1. Not surprisingly, intransitive preferences are frequently observed in the elicitation of expert opinions, e.g., through the method of paired comparisons. The literature on the subject spans many disciplines and I even contributed to it in my work on a multi-criteria decision making technique called the Analytic Hierarchy Process (AHP).

One intriguing aspect of AHP is the derivation of a vector $w = (w_1, \ldots, w_d)$ of priority weights (i.e., positive numbers adding up to 1) for $d \geq 2$ items by comparing them two at a time. The data are stored in a $d \times d$ matrix $A = (a_{ij})$ with entries $a_{ij} > 0$ with the property that $a_{ji} = 1/a_{ij}$ for all $i, j \in \{1, \ldots, d\}$. If a respondent were entirely consistent, one would then have $a_{ij} = w_i/w_j$ for all $i, j \in \{1, \ldots, d\}$. Tom Saaty [54], who developed AHP in the 1970s, noted that the matrix A would then be of rank 1 and w would be an eigenvector corresponding to the largest (Perron) eigenvalue of A. This led him to suggest using this eigenvector, properly normalized, as an estimate of w when A is inconsistent. In [24, 39], my coauthors and I studied the statistical properties of this solution, notably in terms of priority reversals with increasing level of inconsistency, and we proposed an alternative solution based on a linear model.

2 Copulas: Yesterday, today, and tomorrow

How did you first encounter copulas? Is there any anecdote connected with the title of your early paper on "The joy of copulas" [27]?

Soon after I got my first tenure-track position at the University of Waterloo, David Oakes visited from Rochester, NY, and he mentioned Clayton's model in a talk. Its distributional form reminded me of quasi-arithmetic means that I had briefly considered for combining expert opinions. As I was teaching multivariate analysis at the time, I thought this might be a cool way of generating dependence models beyond the multivariate Normal. I then came up unknowingly with the notion of the Archimedean copula. When I presented my findings in a local seminar, a renowned colleague from the Math Department specializing in functional equations, János Aczél, alerted me to the work of Berthold Schweizer and Abe Sklar on probabilistic metric spaces and copulas.

It was a bit discouraging to find out that so much was known already but after pondering for a while, my colleague Jock MacKay and I came to the conclusion that while copulas may be known, they deserved to be better known in statistical circles at least. The time seemed ripe for it or perhaps it was the catchy title of our

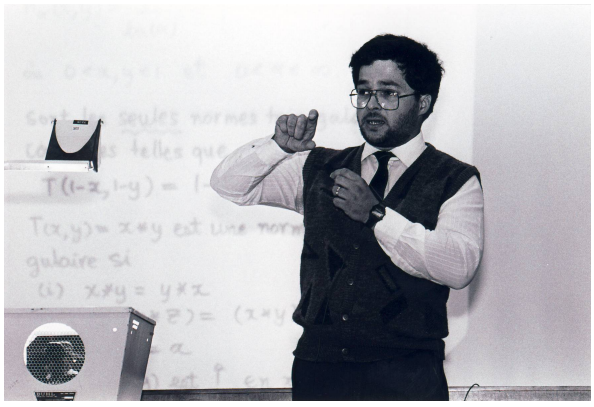

Figure 1: Christian delivering his first plenary talk on copulas at the 15th Annual Meeting of the Statistical Society of Canada in Québec, June 2, 1987. You can discern scribblings about triangular norms in the background.

pedagogical piece in *The American Statistician* that did it; either way our two joint papers managed to draw a lot of attention [26, 27]. This title was a double entendre riding on the popularity of contemporary bestsellers such as *Joy of Cooking* and others. Many years later, Anne-Catherine Favre and I exploited the same thread in a review paper on copula modeling [20] whose title echoed Woody Allen's 1972 comedy film "Everything you always wanted to know..."

You have contributed to copula theory since the mid 1980s and participated in the first conference on "Distributions with fixed marginals" in 1990. How was it back then?

The term "copula" was exotic in those days but the concept is natural and could be recognized in different guises in the work of Hoeffding, Deheuvels, Galambos, Rüschendorf, Kimeldorf and Sampson, and others. Some called them dependence functions, others uniform representations, and Hoeffding thought zero mean uniform margins would be more convenient. Schweizer's "Thirty years of copulas" in the proceedings of the 1990 conference held in Rome gives all the appropriate references [8]. At the time, Schweizer and Sklar were the undisputed leaders of the copula community *sensu stricto*. Most of their results had been obtained in connection with the study of probabilistic metric spaces, though Schweizer had a sense that they could be used in statistics, too. For example, he highlighted the connection between copulas and measures of dependence in his 1981 paper with Wolff [55] in *The Annals of Statistics*.

At the time, however, the potential of copulas for model construction was underexploited, and inference for copula models was almost inexistent. My impression is that very few people had connected the dots between copulas, concepts of dependence, stochastic orderings, rank-based measures, and the empirical copula process. The Rome conference helped me to make these connections. I was still green, and Prof. Schweizer gave me a big boost when he said that my three copula papers in statistics journals [16, 26, 27] had "given the subject a big shot in the arm" [his exact words]. I began dabbling into copula inference but made slow progress during my first sabbatical leave, which I spent in Toulouse in 1990–91.

Which papers of yours have had the greatest impact in copula modeling to date?

Besides the three I just mentioned and my surveys on copula modeling [20] and expert use [42], my most cited papers to date are those in which rank-based inference techniques for copula models were initially proposed or studied [22, 31, 33, 36, 37]. Their high citation counts attest to the huge surge in popularity that copula-based multivariate analysis has experienced in recent years.

Figure 2: Laval Statistics Group dinner held at the Italian restaurant Michelangelo in Québec, April 29, 1999. Front row: Christian, Radu Theodorescu, his wife Marie-José Michiels, Robert Côté, Hervé Morin, Jean-Pierre Carmichael, Bruno Rémillard; back row: Jean-Claude Massé, Philippe Capéraà, Belkacem Abdous, Louis-Paul Rivest, Nadia Ghazzali.

Can you describe how your thinking about rank-based methods for copula inference evolved over the years?

It dawned on me early on that when dealing with continuous random vectors, the underlying copula is unchanged by monotone transformations of the margins, thereby making rank-based techniques a natural tool for inference on dependence parameters. This connection had been made by many people before me, including Hoeffding, Kruskal, Deheuvels, and Rüschendorf. However, I was not fully aware of the literature at the time and ended up coming to the thought independently. It led me to propose rank-based estimators of the parameter of Frank's family of copulas through inversion of Spearman's rho or Kendall's tau in [16]. Anecdotally, I wrote up the first draft in French, as it was still considerably easier for me in those days. Having noted that *Biometrika* had already published papers in French and that no linguistic requirement was mentioned in the journal's instructions to authors, I tried my luck. In inviting a revision, however, the Editor, Sir David Cox, insisted that the paper should be in English to make it more accessible and the journal's instructions were later clarified.

However, it is only when I joined Université Laval and started working with Philippe Capéraà and Louis-Paul Rivest that I took full stock of nonparametric statistical methods. I learned a lot from Philippe's book with Bernard Van Cutsem on the subject [6], which I found truly inspirational. Louis-Paul and I then came up with the Kendall distribution while investigating nonparametric ways of estimating the generator of a bivariate Archimedean copula [38], which became our most cited work. Shortly thereafter, Louis-Paul and I started exploring a rank-based maximum likelihood estimation technique for dependence parameters; we were helped along the way by our first postdoctoral student, Kilani Ghoudi [22]. It is humbling to see that this estimation strategy, which was independently considered by Joanna Shih and Tom Louis [56] around the same time, has become so common that it is now frequently referred to without attribution as the "canonical" maximum likelihood approach.

The next step was to consider goodness-of-fit testing, and my exceptionally fruitful collaboration with Bruno Rémillard was vital in this regard. His academic post was in Trois-Rivières but he actually lived only a few blocks from our house in Cap-Rouge, so we often met for drinks and humorous banter. It is through him that I came to appreciate the central role of empirical process theory in this context and he taught me a great deal about the subject. Together with Kilani and Philippe Barbe [1], we first tackled the Kendall process. Either by ourselves [35] or with PhD students Jean-François Quessy [33, 34] and David Beaudoin [37], we then

explored rank-based tests of independence and goodness-of-fit tests for copula models. In order to compute p-values for these tests, we thought of relying on the parametric bootstrap, but its validity needed to be established in this setting [36]. This paper is one of the most technical I have ever worked on; thanks to Bruno's expertise we managed to make something like a dozen empirical processes converge jointly.

Through my collaboration with Philippe Capéraà and our very talented postdoctoral fellow, Anne-Laure Fougères, I also became interested in copula modeling of extremes. The three of us (CFG) came up with an estimator of the so-called Pickands dependence function, which characterizes extreme-value copulas [5]. Our work was limited to the bivariate case and assumed that the marginal distributions are known, because we did not know how to deal with the corresponding rank-based process. The CFG estimator turns out to be really good (hard to beat in practice, actually), so it drew a lot of attention, in particular from Johan Segers, who later played a key role in establishing the asymptotic behavior of rank-based versions of the CFG and Pickands estimators [41].

Finally, I would be remiss if I failed to mention the main line of work that I have pursued since 2007 with my wife, Johanna Nešlehová. Only her charm and force of persuasion could convince me to join in her investigation of rank-based inference techniques for copula models for discrete data, initiated in [52]. It is a major challenge, fraught with conceptual and technical difficulties linked to the unidentifiability of the copula and the problem of ties. Our first piece together, entitled "A primer on copulas for count data" [31], has been graciously identified by Paul Embrechts [10] as one of the three "must reads" of copula modeling (another one being [20], with [37] as a close runner-up). Since then, Bruno has joined us in our quest of the properties of the empirical checkerboard copula process, which we believe is central to a theory of rank-based inference for copula models for discontinuous data; see, e.g., [32].

You also have interests in actuarial science and finance. How did they come about?

Actuarial science and statistics are related fields, and dependence issues arise naturally in insurance and risk management. I was exposed to these issues while working in Waterloo and Laval, which host the best actuarial research groups in Canada [19]. I then developed a close collaboration with Michel Denuit during my second sabbatical in Brussels, in 1997–98, and upon returning to Québec, I started working with Etienne Marceau and Mhamed Mesfioui [9, 28]; Mhamed was a postdoctoral fellow of mine before taking a position in Trois-Rivières. As for finance, I was dragged into it by my friend Michel Gendron, currently Dean of the Business School at Laval [15]. His enthusiasm is contagious. I also learned a lot from Paul Embrechts during my third sabbatical, part of which I spent in Zürich in 2006.

Thinking of the subsequent copula meetings, what changes did you observe over time?

I did not attend the meetings in Seattle (1993) and Prague (1996) but I went to Barcelona in 2000. This conference, organized by Carles Cuadras, drew a much larger and more diverse audience than in Rome, ten years earlier. By that time, modeling and inference were definitely on the agenda. The influence of Harry Joe's book [43] and Roger Nelsen's monograph [51] was beginning to be felt. This was also the time when Paul Embrechts and his collaborators from RiskLab alerted risk managers to the pitfalls of correlation in *RISK Magazine* [11] and extolled the virtues of copulas. As Gendron, Bourdeau-Brien, and I documented in our 2009 bibliometric study [21], these various publications, along with a 1998 paper by Jed Frees and Emiliano Valdez in the *North American Actuarial Journal* [14], brought about a general awareness of the importance of copulas and dependence in actuarial and financial circles.

In Barcelona, I committed to hosting the next copula meeting in Québec. This event, which I organized in 2004 with Michel Gendron's help, was intended to foster networking among developers and users of copula models, whence the name DeMoSTAFI, which stands for "Dependence Modeling: Statistical Theory and Applications in Finance and Insurance." The conference was attended by some 110 participants from 18 different countries [18]. It was a resounding success. The leading dependence modeling experts of the day were all present, notably Harry Joe, Roger Nelsen, Paul Embrechts, and Jed Frees, but also Vijay Singh, who later played a major role in popularizing copula methods in hydrology.

Another key to DeMoSTAFI's success is that instead of editing conference proceedings, I had the idea of coordinating intertwined special issues in *The Canadian Journal of Statistics* (vol. 33, no. 3) and *Insurance: Mathematics & Economics* (vol. 37, no. 1). Each issue contained the table of contents of the other. The idea of special issues was taken up by the organizers of the next meeting, which was held in Tartu, Estonia, in 2007.

Figure 3: Left: With Roger Nelsen at the 8th Tartu Conference on Multivariate Statistics, June 29, 2007. Right: At the first vine-copula workshop in Delft, Netherlands, with Harry Joe, Dorota Kurowicka, and Roger Cooke, December 16, 2008.

At that point, interest in copula modeling became widespread; many specialized workshops and conferences on copulas and their applications have been organized since then.

Do you think that the interest in copulas will continue to flourish and that "copula" will become a keyword, say, in the Mathematics Subject Classification (MSC)?

Absolutely! The copula concept is fundamental and now that it has been pinned down with a catchy name, we can actually look back and see how it was lurking in the background and occasionally came out of the closet under various guises in the scientific literature. The great advantages of copula-based dependence modeling are now widely recognized and as its use continues to expand to areas like economics, and environmental and health research, I am optimistic that these models will feature in the statistician's standard toolkit for modeling dependence among variables, and finding relations between them, just like regression, generalized linear models, and proportional hazards models. With time, of course, the initial excess of enthusiasm for copulas will be tempered, but with maturity will come a more lucid and balanced view of these models' comparative strengths and limitations.

High-dimensional problems are currently a hot topic and vines are one possible way of addressing this challenge from a copula perspective. The book by Kurowicka and Joe [46] and a special issue of the *Journal of Multivariate Analysis* published in 2015 give a good overview of the developments that have taken place along those lines. Claudia Czado's research group in Munich is clearly leading the charge. Harry's factor copula model approach also holds great promise, and conferences we organized in 2011 and 2014 at the *Centre de recherches mathématiques* (CRM) in Montréal have opened up new horizons in copula modeling, particularly in connection with spatial statistics and machine learning. As for the MSC scheme, it is revised periodically and I am confident that copulas will make the cut in 2020.

Canada has played a key role in developing copula methodology. Any reason why?

As evidenced in a series of bibliometric studies that I produced between 1997 and 2002 (see [23] and references therein), Canada is one of the leading nations in statistical research worldwide. Copula modeling is an exciting and relevant area of research, so it is not surprising that so many Canadians have jumped on the bandwagon. For obvious reasons, many of the early contributors were trained in Québec and Vancouver, but there is now expertise pretty much all around the country. I have been fortunate that my work in the area has long been recognized and supported financially by the Natural Sciences and Engineering Research Council of Canada (NSERC), the Fonds de recherche du Québec – Nature et technologies (FRQNT), the Institut de finance mathématique de Montréal (IFM^2), and more recently via a grant from the Canadian Statistical Sciences Institute (CANSSI) to eight researchers "from coast to coast," as we are fond of saying in Canada.

3 Academic life and our scientific community

Beyond research, you have been heavily involved in the community, e.g., serving statistical associations, journals, and government agencies. What was your motivation?

The goal of science, wrote Karl Pearson [53], is "nothing short of the complete interpretation of the universe," with a view to improving our lives and those of our fellow citizens of the world. This is an ambitious program that we can only hope to achieve if we devote ourselves to the task entirely, act in good faith, share knowledge, cooperate with others, and promote education. I wish all academics were engaged in this selfless pursuit and served, as I did, organizations that share these broad objectives.

Of course, people cannot be moved only by principles, noble and grand as they may be. Personally, I really enjoy working with people in a spirit of collaboration towards a common objective. This explains why most of my research is the product of team work, and why it is always on behalf of the team that I have accepted accolades and distinctions. This team spirit was very much alive at Université Laval, and I have fond memories of our collective accomplishments: a very well integrated and highly original Master's Program in Statistics launched in 1992; the resounding success of the May 1996 conference of French-speaking statisticians for which we organized a chartered flight from Paris [29], and so on.

Through my long-term involvement with the Québec association of statisticians (the French acronym is ASSQ) and the Statistical Society of Canada (SSC), I also met many interesting people and developed long-lasting friendships, notably with Richard Lockhart and David Bellhouse, with whom I ultimately coauthored research papers on the lotteries [25] and the history of statistics [2, 3], respectively. The highlight of my SSC Presidency (2007–08) was the joint meeting with the *Société française de statistique* (SFdS), which brought to Ottawa over 850 statisticians. It is no coincidence that many of the organizers, starting with the co-chairs of the Scientific Committee, Bruno Rémillard and Marc Hallin, are close friends. Marc is himself a world expert on rank-based methods (notably in time series analysis); we started collaborating while I was on sabbatical in Belgium and still see one another regularly.

In recent years, I have been privileged to experience again this intense spirit of collaboration while organizing workshops at the CRM and co-editing two books, one for the 50th Anniversary of the Committee of Presidents of Statistical Societies [48] and another commissioned by the SSC for the International Year

Figure 4: Sixteen presidents of the Statistical Society of Canada photographed at the banquet of the Society's 36th Annual Meeting held in Ottawa, May 28, 2008. From left to right (ignoring the rows): Román Viveros, Louis-Paul Rivest, Bovas Abraham, David Bellhouse, David Binder, Michael Stephens, Agnes Herzberg, Jim Zidek, Mary Thompson, Nancy Reid, Richard Lockhart, Jerry Lawless, Urs Maag, Christian, Ivan Fellegi, and David Brillinger.

of Statistics [47]. They were both favorably received (e.g., they were identified as "books of the year" by the magazine *Significance*) and are available for free on the societies' respective websites.

Now it may be that I tend to overemphasize community work because of my Christian upbringing. However, it pains me to see that so many young colleagues refuse to get involved because it does not pay, hinders their productivity or reduces their chances of earning a merit pay, a grant, a promotion, or an award. Of course, these things are nice when they come, but this is not why we do what we do. It doesn't take a rocket scientist to understand the ethic of reciprocity: you cannot expect others to treat you with respect, review your work quickly, and cite it abundantly when you judge people rather than their work, reference others sparsely, and turn down most refereeing requests.

You have served as Editor-in-Chief for two journals, and as an Associate Editor for at least 10 others. How much time do these activities take, and does it differ across journals?

It's good that you ask because it can indeed vary. For most journals where I served as an Associate Editor, the workload varied between 1 and 2 new papers per month, so that taking into account revisions, I might have 5–6 active files at any given time. However, I was listed for years on end on the Editorial Board of a journal called *Modulad* that never actually asked me to handle a single submission!

Serving as an Editor-in-Chief is a much greater commitment of time and energy. During my three-year stint with *The Canadian Journal of Statistics* (CJS), I received close to 400 new submissions. This translated into about 6 hours of work per week and I could still find time to referee 15–20 papers a year for other journals. The *Journal of Multivariate Analysis* (JMVA) operates on a much larger scale: it receives over 550 submissions per year and so far, I have had to devote approximately 3 hours per day to journal management. So no more side refereeing for me!

The peer review system has been under intense criticism and scrutiny over the past few years; see, e.g., [4]. What challenges are facing the current scientific editorial system?

The problem is not so much with the peer review system *per se* as with people's attitude towards it. From my vantage point as an Editor, alas, I often witness questionable behavior both from authors and referees. Plagiarism and simultaneous submissions of the same paper are clearly reprehensible; yet they occur. There is also an increasing tendency to fragment results into multiple publications, to refrain from citing competitors in the hope of avoiding them as reviewers, and upon rejection of a paper, to submit it to another journal without taking into account any of the referees' comments (not even typos). Then there are referees whose behavior borders on obstructionism, who make unnecessarily harsh or demeaning comments, or who just can't resist trying to get authors to write papers in their own style. These attitudes, and many others like them, are potentially harmful to researchers' careers and journals' reputations. It is my duty as an Editor to ensure the integrity of the reviewing process. Luckily, a very large proportion of authors and referees are still honest, competent, and benevolent.

Of course, new issues keep arising that require editorial leadership. For example, a major concern in the statistical community of the 1980s and 1990s was the perception that new researchers, women, people from third-world countries, and members of visible minorities were possibly treated unfairly. To solve this problem and ensure that the work, not its authors, is judged on merit, double-blind refereeing was introduced as early as 1989 by the CJS, under Marc Moore's editorship; I was proud to be on his team. A few years later, I made a passionate plea in favor of this practice in an invited discussion on the report [7] commissioned by the Council of the Institute of Mathematical Statistics to look into the matter. With time, many journals went down that road but double-blind refereeing is now much less effective than before because many authors feel compelled to post their manuscripts on `arXiv` or other public platforms in advance of the review process. At this point, I am not sure what else could be done.

Here is another illustration of the changing times. An editorial change that I am particularly proud of is the introduction of electronic paper submission and the inauguration of a website for the CJS at the start of my term as Editor-in-Chief. The SSC, which owns the journal, supported my initiative but could not provide any funding. As a result, once my children were in bed, I spent many nights in the autumn of 1997 (while on sabbatical in Brussels) building a database (authors, titles, abstracts, etc.) that could be searched online for past publications all the way back to vol. 1 (1973). This website, which I maintained *pro bono* for over 10 years, received an Internet Guide Award from *Encyclopædia Britannica* in 1999 but was abandoned when Wiley was

asked to take over the production. This was a bitter disappointment to me, especially given that the decision was made (against my will) by the SSC Board of Directors on a split vote during my presidency.

But life is full of surprises and we all need to adapt, as I was reminded when I was Director of the *Institut des sciences mathématiques du Québec* (ISM) from 2012 to 2015. The ISM is a consortium of nine Québec universities that coordinates training and fosters collaboration throughout the province in the mathematical sciences. At the start of my term the problem arose of replacing the volunteers who had been producing the community's time-honored peer-reviewed journal, *Annales mathématiques du Québec* (formerly *Annales des sciences mathématiques du Québec*). Nobody wanted to step up to the plate. To ensure the journal's survival, I had to bring myself to sign a deal with Springer for the production of that publication. We have been happy with the results. The Editor-in-Chief, Claude Levesque, played a major role in initiating the negotiations and did a superb job of running the journal through these troubled times. I am also grateful to François Lalonde, CRM Director, for supporting the initiative.

Of course, no one will have failed to notice that today, after working for so many years in volunteer organizations, I am editing the *Journal of Multivariate Analysis* (JMVA) on behalf of Elsevier. Beyond the personal challenge of running an international journal of this caliber, I see this new responsibility as a golden opportunity to influence the development of the discipline. One current problem we face is the need to support authors in complying with their national agencies' open access requirements for funded research. One step in that direction is Elsevier's Editor's Choice Program, which JMVA is about to join at my initiative. Each year, the journal's five best papers will be open for all to access and read.

With your editorial experience, is there a paper of yours you'd write differently now?

In my younger years, I thought of scientific papers as gemstones or artwork of eternal value. With time, however, I came to realize that they represent snapshots of an author's thinking. Each time you write a paper, you are addressing the community. Before you speak, you should ensure that you have something worthwhile to say, and in order to be taken seriously, you should get your facts straight; otherwise, you're not helping. But out of respect for the audience, you should also strive to convey your vision as concisely as you possibly can without impairing clarity. This requires a great deal of reflection and a lot of attention to detail. I have always tried to abide by these principles. So, placed in the same circumstances, there is probably very little I would change to any of my papers — just some annoying typos. As time unfolds, however, thinking evolves, ideas crystalize, and simpler ways of expressing oneself emerge. In that sense, most of my papers would need to be written differently today.

Is there any paper you regret having written, then?

Knowing who is asking, you are probably hinting at the infamous paper by Thomas Mikosch [49] and the ensuing discussion to which Bruno Rémillard and I contributed together. Given the contents and tone of this pamphlet, we felt compelled to reply tit for tat and we would do it again today if necessary. Unfortunately, it threw a monkey wrench into my fledgling relationship with Prof. Mikosch, who is both a highly respected scientist and a charming man. Our first face-to-face meeting in Oberwolfach in March 2008 was awkward, to say the least, but we eventually made peace. My only regret is that I failed to dissuade the Editor of *Extremes* from publishing this acrimonious exchange in the journal. On the lighter side, I have come across a number of papers that actually cite Mikosch's article in *support* of copula modeling! Unsolicited advice: Always check your sources before you cite them.

Reflecting more broadly on my academic career of 30+ years, I would say that while I am not aware of anything that is factually wrong with any of my papers, those that I am least proud of are the very few that I obstinately insisted on getting published in spite of repeated rejections. At the time, I thought I had good reasons for persisting — the imminence of a tenure or grant review sometimes induces such behavior. With hindsight, however, I should have let go and simply weathered my unproductive spells.

All researchers experience periods when they feel unmotivated or uninspired. This often happens to people just after they complete their PhD, but it can strike anytime. Common causes include heavy teaching or administrative loads and excessive amounts of graduate supervision, not to speak of health issues, family problems, and other personal circumstances. In my own experience, extensive travel can ruin your concentration and creativity, too. There was a brief period in my life when I felt like a performing artist on a world tour, always playing the same hits, with no time to write new songs.

You are actually known to be an excellent speaker. What are the three most important things one should consider in preparing and delivering a talk?

I am tempted to reply "Practice, practice, practice." And practice I did! When I was proposed for election to the Royal Society of Canada (the highest honor that has been bestowed upon me), I had to provide a count of my invited talks, which came to a staggering figure: 275. Whatever the venue, I try to construct my talks as if they were short movies, thinking carefully of the scenario, the characters, etc. You have to gauge your audience and engage it by juggling the elements of the plot with clues, detection, and so on. I try to avoid dull, linear story lines by inserting twists, historical tidbits, and funny remarks without detracting from the main message. The broader the audience, the tougher the challenge. I am particularly proud of the scores of talks that I gave in junior colleges (cegeps) around the province of Québec since the early 2000s. It became a regular (in part promotional) activity when I started my term as Director of Laval's Statistics Undergraduate Programs, and I continued ever since. These talks draw heavily on my consulting experience via Waterloo's Institute for Improvement in Quality and Productivity (IIQP) and Laval's Statistical Consulting Service (SCS), with Statistics Canada, and as an expert witness.

What is your favorite statistical joke?

I always enjoy a good laugh and if you look carefully, you'll find that my writings are sprinkled with subtle humor. I even made an attempt at writing a funny piece [17] for *SSC Liaison*, the magazine of the Statistical Society of Canada that I have helped to edit almost continuously since its foundation in 1986. I also used to crack lots of jokes in class but as political correctness set in, I became increasingly selective in my choice of topics in order to avoid offending anyone. For spoofs, parodies, and satires about science, I would suggest *The Journal of Irreproducible Results* and the classic book *A Random Walk in Science* [57]. My favorite story is James Miller's description [50] of how Sir Isaac Newton, overburdened with administrative chores, discovered the law of gravitation when an unexpected cancellation in a series of late evening committee meetings allowed him to take a short walk and see an apple fall on the ground...

4 Miscellanea

Name and prioritize the most important ingredients for a successful academic career.

Taking for granted that you already meet the basic requirements, i.e., you have a PhD, the knowledge, and the talent that go with it, I would say (1) passion, (2) hard work, and (3) resilience. The first two go hand in hand. Academic life looks deceivingly easy to the outsider. Ordinary people think that we teach only six hours a week and that we have long holidays in the summer. But in effect, knowledge is only acquired and retained, let alone discovered, at the cost of constant effort. The environment is in perpetual motion and we are surrounded by young, eager folks who want to prove themselves, so we constantly need to renew ourselves, adapt, innovate.

Over the past 30 years, demands on university professors have also increased substantially, at least in Canada. We have no secretarial help to speak of, minimal teaching support, ever increasing group sizes, and pressure to train more and more "highly qualified personnel" (i.e., students). At the same time, expectations have risen considerably in terms of productivity and accountability. So unless you are passionate and work really hard (over 70 hours a week in my case, essentially all year round), you cannot make headway in research because so much of your time is devoted to administrative tasks and the incessant assessment of papers, theses, grant proposals, promotion cases, etc. Exactly as portrayed by Miller [50], which is maybe why I find his story so funny: it strikes a chord with me. Anyway, all this we do for the love of knowledge, to advance the cause, devoting our best hours to it every day, and yet we face mean teaching evaluations, harsh reviews, many rejections, and so on. The temptation to quit is very strong, always, so to make it you need to be highly motivated and resilient.

Figure 5: Christian and Johanna (far right) sharing a meal with Bruno Rémillard and his wife Line Dubé, January 8, 2012.

To what extent does luck play a role? Does it help to work at a top-tier university?

Spontaneously, I would say that "luck is very important" in the sense that I am lucky to be healthy, loved, employed, living at peace in a tolerant country, etc. For these many blessings, I am very grateful. However, maybe your question implies that these factors are explanatory variables and luck refers to the residual, unexplained variability. Pondering the issue, I was reminded of the times when my two oldest sons played hockey. Through them, I met former professional hockey players who all considered that beyond a certain level of skill, the game was just a matter of luck — good or bad bounces of the puck, as they would say. It's called the "impostor syndrome," I think, and we all suffer from it to an extent.

Now if you hope to win the Stanley cup or the world championship, your chances are better if you play for a strong team. Same for universities of prestige. They tend to be better funded, to attract better students, to hire stronger people, etc. I have been fortunate to work in some of Canada's finest institutions of higher learning, and I have good friends in them all. Of the three, Waterloo is the strongest in mathematics, statistics, and actuarial science. Laval is also excellent in the latter field and although the statistics team remained small in my 23 years there, it was very harmonious and united in its purpose. "Small vectors all pulling in the same direction" is the way we were once described. In contrast, some vectors at McGill cast a fairly long shadow. The university ranks consistently among the top 20 universities worldwide, notably because of its great medical school, and the Mathematics and Statistics Department has been very generous to me. In particular, the creation of the Canada Research Chair in Stochastic Dependence Modeling has attracted a lot of attention to my area of research.

Your wife, Johanna Nešlehová, also works at McGill and in dependence modeling. What are the pros and cons of being married to someone in the very same research field?

Johanna is a wonderful companion, and we enjoy doing research together, though we share many other passions, of course. To address your question in more general terms, I would say that being married to an academic has many advantages: both parties understand the imperatives of the profession and can support one another at critical moments because their schedules are flexible. It is particularly good when they can be at the same institution, or at least in the same city — the famous "two-body problem" — and coordinate their sabbaticals. I know many such couples; in fact, there are even some in my own department. The main challenge, I would say, is to be disciplined enough to leave work problems at work, by which I mean the unpleasant ones involving politicking and administrative issues.

In his autobiography [58], Norbert Wiener wrote: "Severe work of research nature drains one dry, and without an ample opportunity to rest as intensely as one has worked the quality of one's research must go down and down." What is your favorite activity outside academia?

Child rearing is an absorbing activity that I have enjoyed for many years and that has kept me busy to this day. I have four children: Marianne is a psychiatrist, currently in Lille, France; Arnaud is a solution developer for a Québec-based company that designs and installs packaging line vision inspection and control systems for the pharmaceutical, medical, and chemical industries worldwide; Vincent holds a PhD in mathematical

physics from the Université de Montréal and is currently an instructor at the Massachusetts Institute of Technology; and finally, Richard is a toddler who enjoys music and paints frescos while learning Czech and French simultaneously with his parents.

Parenthood brings with it its share of joys and sorrows but it is highly gratifying overall and it has brought me many places: concert halls, summer camps, hockey rinks, and baseball fields, among others. This eventually led me to become a *real* baseball coach, and later an umpire. It kept me busy most summer evenings for the better part of 10 years. Since the age of 12, I have also been regularly involved in community services and charitable organizations, and I pursued interests in languages and history that even led to published work in statistics journals, as I mentioned earlier.

Now if you meant "pure relaxation," I would reply mainly walking, hiking, watching movies, and going out to plays and concerts with my wife. I love the absurd humor of the British surreal comedy group *Monty Python* and the French comedy medieval fantasy television series *Kaamelott*. On the serious side, I am an avid fan of contemporaneous Canadian playwright, actor, and film director Robert Lepage. His work touches me deeply and, in particular, his award-winning 2003 film "La face cachée de la lune" (Far Side of the Moon), which portrays the atmosphere that prevailed in the 1960s; I find it significant that it is cast in the context of the USA-USSR space race.

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