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INNHOLD

	Side
Fra redaktøren. *Inge Helland*	1
Fra formannen. *Eivind Damsleth*	2
Siden sist	
Nekrolog over Erling Sverdrup. *Ørnulf Borgan og Arnljot Høyland*	3
Erling Sverdrup - Portrait of a Pioneer in Actuarial and Statistical Science in Norway. *Ragnar Norberg (1989)*	4
Faglig stoff	
Mer paradox. *Erik Mønness*	11
Improving the odds on justice? *New Scientist, April 1994*	12
Bokanmeldelse: Natvig og Nordseth: Sannsynlighetsregning. *Inge Helland*	14
Konferanse	
3. Spruce conference. Merida, Yucatan, Mexico	15
Meldinger	
Nytt fra Universitetet i Oslo	16
Nytt fra Universitetet i Bergen	17
Nytt fra gruppe for statistikk, NTH	18
Høylands dag. Statistisk forening Trondheim.	19
Medlemskap i Norsk Statistisk Forening	20
Bidrag til TG	20

Fra redaktøren

Forrige nummer av TG var nettopp gått i trykken da meldingen om Erling Sverdrup's bortgang kom. Med dette er grunnleggeren av det norske matematisk statistiske miljøet borte. Det jeg sa i forrige leder fikk med dette dobbelt vekt: Nå er vår generasjon nødt til å overta hele ansvaret.

Vi overtar i en verden som ikke er blitt lettere, heller ikke for statistikere. Et spesielt problem for oss i dag er den utfordringen som ligger i forhold til andre miljøer som også driver dataanalyse og metodeutvikling. Nevral nettverk-miljøet har tidligere vært diskutert i TG av Knut Liestøl (desember 1992). Det som gjøres innenfor dette miljøet, er formulert på en for oss uvant måte ut fra noder og forbindelser mellom noder, men i virkeligheten arbeider de med metoder som konkurrerer med regresjon, diskriminant-analyse, klusteranalyse osv.. Spesielt interessant er språkbruken: De snakker om 'læring' der vi snakker om 'estimering', om 'pruning', som inneholder det vi kaller 'variabelutvelgelse' i multippel regresjon, osv.

En del av de beste innenfor dette feltet er opptatt av kontakt med statistikere. Ordet 'generalisering' er kommet mer i forgrunnen innenfor nevrale nett, og det dekker mye av det samme som vi tenker på når vi ser på forholdet mellom populasjon og utvalg. Bayesansk tankegang har vært lansert innenfor nevrale nett for å regulere antall noder. Og så videre. Men fremdeles dreier det seg for en stor del om disjunkte verdener.

Lignende nesten vanntette skott mot statistikken finner en også mot andre dataanalyse-miljøer, for eksempel til en viss grad hos kjemometrikerne. En meget dyktig forsker jeg snakket med forleden, spesialist på analyse av matvarer, drev daglig med PLS-regresjon i forskjellige varianter, men hadde aldri hørt om vanlig multippel regresjon.

Kanskje er det riktig at vi bør prise mangfoldet. Men for bevisste brukere av metoder må situasjonen være meget forvirrende: Er det tilfredsstillende at mitt valg av metode til å analysere mine konkrete data skal avhenge i så sterk grad av hvilken skole jeg har lært metodikk fra? Selvfølgelig kan det sies at en intelligent bruk av metoder alltid vil føre til fornuftige konklusjoner. Likevel mener jeg at det ligger en meget stor utfordring til statistikere i hele denne problemstillingen: Ikke nødvendigvis bare i det å markedsføre våre egne metoder, men vel så verdifullt i å videreutvikle det som kanskje når alt kommer til alt det viktigste i vår kultur: Vi har i den matematiske statistikken kombinert med dagens muligheter for simuleringer kraftige metoder *til å vurdere metoder*. Dette arsenalet er langt fra godt nok utnyttet.

Inge Helland

Fra formannen:

LÆRE FOR LIVET ELLER LÆRE FOR EKSAMEN

Det var sikkert flere enn meg som med interesse leste om doktorgradsarbeidet i Trondheim, hvor et antall forholdsvis nyutdannede siv.ing. fra NTH uforberedt ble bedt om å "gå opp til eksamen" en gang til. Selv om det bare var noen få år (kun ett for flere) siden deres virkelige eksamen, strøk samtlige.

Kandidatene har min fulle sympati. En rask mental gjennomgang av mine fag fra Blindern (riktignok for 20 år siden) tilsier at jeg ville være i samme båt, i hvertfall for en god del av fagenes vedkommende. Både Kompleks analyse, Integrasjonsteori og Grensesetninger i sannsynlighetsregningen ligger under ganske tykke lag med støv, beklageligvis (eller heldigvis?).

Men dermed er ikke sagt at undervisningen og tiden som ble brukt på disse fagene var bortkastet. For det første ligger nok kunnskapene dypt begravet ett eller annet sted, og kan forhåpentlig forholdsvis lett reaktiveres, dersom det skulle bli nødvendig. For det annet har jeg fremdeles en viss forståelse for hovedprinsipper og nøkkelresultater, selv om detaljene og de tekniske ferdigheter er svunnet hen. Og endelig, prosessen med å lære og forstå nytt stoff, benytte det i en kort periode (til eksamen) og så glemme er i høy grad relevant for den typen prosjektarbeid mange av oss driver med til daglig.

Likevel, det var da en tankevekker ...

27. mai 1994
Eivind Damsleth

Erling Sverdrup

En nestor blant norske statistikere, professor dr. philos.Erling Sverdrup er død, 77 år gammel.

Sverdrup var aktuarstudent da Tyskland overfalt Norge 9. april 1940. Han meldte seg samme dag frivillig til tjeneste i Den norske generalstaben og fulgte denne nordover under hele felttoget. Han var en viktig person i den lille gruppen som sørget for sikker chifferkorrespondanse mellom de ulike norske avdelingene oggeneralstaben. Da kampene i Nord-Norge opphørte tok Sverdrup seg over grensen til Finland hvor han ble chiffermann hos den norske militærattasjeen i Helsingfors. Deretter ble han i tur og orden beordret til Stockholm, Moskva, Tokyo og Washington DC for å organisere det norske chiffersambandet. I mars 1942 kom Sverdrup til London hvor han arbeidet i den norske chiffertjenesten. Oktober 1944 ble han sendt til det frigjorte Finnmark, der han tjenestegjorde inntil Tysklands kapitulasjon.

Sverdrup fullførte sin aktuarembetseksamen ved Universitetet i Oslo høsten 1945. Etter en kortere tid som sjef for forsvarets sentrale chifferkontor, ble han i 1946 knyttet til det økonometriske miljøet rundt Frisch og Haavelmo. Dette fikk avgjørende betydning for hans interesse for statistikkfaget. Sverdrup ble ansatt som vitenskapelig assistent, og eneste vitenskapelige ansatte, ved Forsikringsteknisk seminar i 1948. I 1949-50 var han Rockefeller-stipendiat, først ved University of California, Berkeley, deretter ved University of Chicago og Columbia University, New York. Han tok sin doktorgrad i 1952 med en avhandling om et desisjonsteoretisk emne, og ble i 1953 utnevnt til professor i forsikringsmatematikk med matematisk statistikk ved Universitetet i Oslo.

Sverdrup gikk straks i gang med å revidere studiet. Statistikk var den gang ikke etablert som eget fag ved noe norsk universitet. Sverdrup valgte derfor å konsentrere seg om arbeidet med å bygge opp et moderne studietilbud i statistikk for aktuarer og andre realfagsstudenter. Matematisk statistikk ble etablert som bifag i 1955 og som hovedfag i 1956. Deretter reorganiserte Sverdrup undervisningen i forsikringsmatematikk slik at denne ble basert på den nye grunnutdanningen i statistikk. Han tok så opp arbeidet med å skrive egnede lærebøker. Hans to-binds verk, ``Lov og tilfeldighet", har hatt meget stor betydning for utviklingen av statistikkfaget i Norge. Bøkene er senere revidert, oversatt til engelsk og gitt ut på et internasjonalt forlag.

Sverdrup har i sine vitenskapelige arbeider særlig behandlet de generelle prinsippene for konstruksjon av statistiske metoder. Han har blant annet levert viktige arbeider om optimale statistiske tester og multiple metoder. Han har også levert betydningsfulle bidrag innen livsforsikringsmatematikk og statistisk forøpsanalyse. Hans arbeider i forløpsanalyse har vært et utgangspunkt for den sterke norske og skandinaviske tradisjonen på dette feltet.

Sverdrup ble innvalgt som medlem av Det Norske Videnskaps-Akademiet i 1954, og av Det Kgl. Norske Videnskabers Selskab i 1981. Han var norsk medlem av International Statistical Institute, Fellow av Institute of Mathematical Statistics og æresmedlem av Den norske aktuarforening og Norsk statistisk forening. Sverdrup var norsk redaktør av Skandinavisk Aktuarietidskrift 1968-82 og formann i Forsikringsrådet 1970-74.

Sverdrup var en inspirerende lærer med utpreget evne til å se de viktige prinsipielle sidene av et problem uten å tape seg bort i matematiske detaljer. Han hadde sterke meninger om statistikkens idemessige grunnlag, men var likevel åpen for nye utviklingstendenser i faget. Han var en intellektuell i ordets beste forstand med store kunnskaper også utenfor sitt eget fag. Sverdrup kunne i offisielle sammenhenger virke reservert og formell. Men de av oss som var så heldige å bli nærmere kjent med han, lærte å kjenne et varmt og levende menneske med humoristisk sans og interesse for andres ve og vel. Minnet om et fint menneske og en imponerende karriere vil leve lenge blant oss.

Ørnulf Borgan Arnljot Høyland

Fra: Nordberg, R.[ed.] (1989) *Twelve Contributions to a Tradition in Statistics and Actuarial Science. Festschrift to Erling Sverdrup.* Almqvist & Wiksell International.

Erling Sverdrup—Portrait of a Pioneer in Actuarial and Statistical Science in Norway

RAGNAR NORBERG
University of Oslo

Erling Sverdrup, mathematical statistician, born in Bergen, Norway, February 23. 1917, son of Georg Johan, Prof., and Gunvor (Gregusson) Sverdrup. Actuarian, Univ. of Oslo 1945, Dr. Philos. 1952. Statistical consultant at Inst. of Economics, Univ. of Oslo, 1946–48, research assistant at Inst. of Insurance Mathematics, Univ. of Oslo, 1948–53, professor of actuarial mathematics and mathematical statistics at Inst. of Mathematics, Univ. of Oslo 1953–84, senior research scholarship, Norwegian Research Council for Science and the Humanities, 1984–87. Rockefeller Foundation fellow at Univ. of California at Berkeley, Univ. of Chicago, and Columbia Univ., 1949–50, Visiting professor at Columbia Univ., New York, 1963–64 and at Aarhus Univ., 1969, Research officer at the Central Bureau of Statistics 1977–78. Fellow of the Institute of Mathematical Statistics, member of the Royal Norwegian Academy of Sciences and the International Statistical Institute. Author of "Laws and Chance Variations", North-Holland, 1967. Research on sampling distributions in multivariate analysis; developed theorem on limit distributions of continuous functions of random variables; minimax procedures in statistical inference and statistical prediction; relationship between unbiased (similar) test procedures and conditional testing for general exponential classes of distributions, generalizing and reformulating Neyman–Pearson's theory; estimation and test procedures for forces of decrement and transfers in statistical follow-up studies. Home addresss: Olav Kyrres gate 4, N–0273, Oslo 2, Norway.

This text, taken from *Who's Who in the World,* updated and slightly extended, is, presumably, an adequate mention of the world citizen Erling Sverdrup. To a readership of statisticians much has to be added, however.

To begin with the list of exclusive memberships, Sverdrup was elected honorary member of the Norwegian Statistical Society at the Society's general assembly in Bergen, 1987. The event marked the 70th anniversary of Sverdrup's birth in the very same city and was an expression of acknowledgement of his endeavours to build statistics in Norway.

Sverdrup is a member of the Norwegian Polytechnical Society and, of course, the Norwegian Society of Actuaries, where he has played a prominent part as lecturer and discussant. In his lecture "Scientific requirements in the actuarial profession" [13] presented to the Society on the occasion of its 50th anniversary in 1954, the then newly appointed professor outlined his vision of a modern actuarial study programme. Its primary objective is not to teach the students how to run the daily routine work in an insurance company, but to *educate* them: make them firmly acquainted with the mathematical–statistical basis of actuarial science and introduce them to scientific method through one year's work on a thesis, thus enabling them to formulate and solve new practical actuarial problems currently arising in a rapidly developing society. This talk gave rise to discussions through many years, a committee report and new meetings. A quarter of a century later, in 1979, the programme was put into effect, with full support from the Society. Already as Sverdrup entered upon his duties as professor, he made important steps to build a scientifically based actuarial education by designing courses in insurance mathematics founded on modern probability theory and statistics. The

forerunners of [25] and [26] were decades ahead of contemporary textbooks in insurance mathematics. Today Norway can parade a number of actuaries engaged in basic and applied research, steadily contributing to international scientific journals.

At pensionable age, Sverdrup retired from the senior scholarship he held in the three last years of his working career. Thus, his present position is pensioner, Professor emeritus at the University of Oslo. None the less, the present survey of his works and activities can only be provisional: it seems that Sverdrup for the time being is in one of those periods of feverish enthusiasm which—according to himself—have been characteristic of his research work.

The scientific production that grew out of these periods is considerable—in the true sense of the word. Actually, Sverdrup has been reticent in publishing his results in the traditional form of papers in journals. A number of significant contributions have remained unpublished or they have been placed in memoranda, lecture notes or textbooks without visible claims of originality. A typical case is the chapter on moving averages in [16]–[17], which gives precise mathematical formulation of, and solves problems related to, the graduation of vital rates, time series, etc. Another example is the volume of lecture notes [25], which treats problems of life insurance in a probabilistic setting that accommodates studies of the risk associated with the single policy and the entire portfolio. The text includes also an original and clarifying treatment of safety loadings in life insurance and their return by bonus allotment schemes. Also [27] and [29] ought to be mentioned. In a chat I once had with Severdrup on the publish-or-perish-syndrome, he uttered: "If one should write something, it must be to express what one has most at heart". All his writings are well reasoned, with a clear concern and message.

A special commitment can be traced in the works on statistical decision theory. The thesis for the doctorate [9] states and proves a number of results on admissibility and minimaxity, both with and without use of least favourable distributions. Some of them have acquired a firm position as key theorems in the field. In the introduction to the thesis Sverdrup states that some of the results were in the air at that time, but on the whole this work must be recognized as an important early contribution to the development of the general theory on admissible and minimax procedures. Its import is also due to the efforts made to find admissible minimax solutions to certain prominent testing problems in normal models, which added knowledge about the feasibility of the minimax criterion.

Paper [11] marks a turning point in that Sverdrup here gives his last contribution to minimax theory and commences his concentrated studies in the foundations of the Neyman–Pearson theory of testing statistical hypotheses. In [11] he streamlines and extends the theory on the mathematical side. An elegant proof, based on analytic continuation, is given for a generalized version of Neyman and Pearson's result about the construction of similar tests, covering both discrete and continuous distributions. The role of similarity as a necessary condition for unbiasedness is made lucid, and the classical Neyman–Pearson lemma is presented in a general form for unbiased tests of hypotheses in the multiparameter exponential family of distributions.

Later works ([19], [27], [34], [35], [37], [38], [55]) clarify the practical interpretations of the Neyman–Pearson theory and relate it to general scientific method. In particular the interpretation of the role of the null hypothesis in the context of multiple testing has brought relief to statisticians. Here are some excerpts from the philosophy:

— The statistical method should be derived from a model embodying all relevant *a priori* knowledge/insight about the mechanisms that generate the data. The properties of a method can be assessed only when it has been specified in advance which conclusion is to be drawn for each possible outcome of the observations ([16]–[17], Chapters I and VI). The statistical method should be judged from the characteristics of the performance

function. Its behaviour must be explored for any distribution which cannot *a priori* be excluded.

— A statistician who believes that he looks at the observations before he constructs the method, hides part of his model in his subconscious mind. It is indeed impossible to look at the observations in advance. It would be pulling yourself up by your hair ([27], pp. 44–47).

— It is not contradictory to test null-hypotheses which are known to be false and would have been rejected anyhow if the number of observations were large enough. The null-hypothesis should properly be called the null-state. It is chosen, not because we have any *a priori* confidence in it, or are interested in the truth of it, but because we are interested in certain effects which are contrasts to the hypothesis. The test is just a clearance test, performed initially to determine whether or not to search further for significant contrasts/departures from the hypothesis (see [38]).

— Alone and by itself the null-hypothesis gives no guidance to the choice of a test. The purpose of the test and hence criterion for designing it becomes clear only when one has specified the alternatives it is to be tested against (see [35], [38], [55]).

Besides the influential works in statistical decision theory, Sverdrup's early contributions to modern life history analysis are recognized as the origin of a strong tradition in actuarial and statistical research in Scandinavia. Key references are [18] and [21].

The principles of statistical inference that have been so vigorously advanced by Sverdrup, with emphasis on the model as the basis for analysis of data, are apparently inspired by, and carry forth the style of scientific thinking that prevailed in the school of Ragnar Frisch, Trygve Haavelmo, Olav Reiersøl and other influential Norwegian econometricians.

The laconic formulations in *Who's Who in the World* cover up the circumstance that Sverdrup was appointed professor of statistics at a time when this academic discipline was in a state of infancy in Norway, and the building of an educational system and an environment of statistics was a great challenge. Sverdrup seized the psychological moment—and was seized by it and by the following three decades of steady commitments, with numerous initiatives for the good of the statistics profession. The archives of the University of Oslo contain innumerable documents signed by him: strategic plans for education and research, study programmes and curricula, appraisals of applicants for positions, evaluations of theses and doctoral dissertations, reports from working parties and committees, and records of all kinds of run-of-the-mill matters. These documents maintain reflected points of view concerning the university's role in society, advocating the unity of education and science and freedom of research—in particular the rights of the researcher to choose topics of study and publish results—freed from the necessity of producing short-term results for external contracts. Already as a research assistant he became head of "Forsikringsteknisk seminar", the forerunner of the Section of Actuarial Mathematics and Statistics. He was head of the Section through the bulk of his time as professor, and has also served as head of the Department of Mathematics and chairman of the Faculty Committee of Budgeting and Planning. In administrative work he combined thorough insight in procedural matters with the best of political calculation, always soberminded, never hiding anything.

In addition to his administrative work-load at the university, Sverdrup was Norwegian editor of the *Scandinavian Actuarial Journal* 1968–82, chairman of the Norwegian Council of Insurance Supervision 1970–74, and chairman of the Norwegian Mathematics Council 1974–76 (vice-chairman 1973–74).

Also in his teaching Sverdrup is a reflected man. His abilities as a teacher are not only the result of natural talent, thorough preparation and an excellent grasp of the material. He

regards lecturing as an act of dramatizing the subject. What is hard to convey by the written word are the motivation and the overall structure, the highlights, snags and pitfalls. He presents his lectures with vigour and elegance, stepping out briskly in front of the blackboard—once in a while on his tip-toes with excitement at a beautiful result. Sverdrup managed to keep his students' fascination for the subject and brought them further than their reading would have taken them.

During the Second World War Sverdrup devoted himself entirely to the fight for freedom. I have heard him make one statement in public on this stern period of his life: "I usually deduct five years from my age". I consider it appropriate to add some information I have obtained from a first-hand source, Karl Borch, whose career has striking parallels to that of Sverdrup. They were fellow students, and both served as intelligence officers in the Free Norwegian Forces during the war, thereby suffering a five-year-long break in their studies. They resumed their studies upon the conclusion of peace, received their actuarial degrees, and ended up as professors of insurance (Borch at the Norwegian School of Economics and Business Administration, Bergen). In a very personal and frank letter dated 24 November 1986, Borch wrote to me (translated extract):

> In the autumn of 1939 the General Staff organized a course in ciphering at the university, with the purpose of building a group of cipher experts who could be called up when needed. I was recruited by actuary Per Gotaas, and I think he also was the one who recruited Sverdrup.
>
> On the night of 9 April 1940, Sverdrup reported for duty and followed the General Staff northwards. For this I admire Sverdrup. He knew immediately—with an unfailing instinct—what was the right thing to do. Sverdrup was exempted from military duty for medical reasons and, therefore, was not under mobilization orders. He nevertheless volunteered.
>
> He was sent to Helsinki, Moscow and Tokyo to organize the cipher service at the Norwegian legations there. Then he was ordered to Washington and, in 1942, to London, where he was in charge of a special military cipher service. In 1944 he was sent back to the northern part of Norway after it had been liberated by the Red Army, and he served there until the German capitulation. He had then attained the rank of captain.
>
> In the Norwegian *Who's Who* Sverdrup makes no mention of his war effort. I don't know why he has been so reticent and stayed in the background. I think you should pass on some of what I have told here to throw light on the character of Erling Sverdrup. His merits in the struggle for freedom were known to many, but most of them have passed away.

Karl Borch died on 2 December 1986, one week after he wrote this letter.

Other personal characteristics of Erling Sverdrup are well known to his acquaintances. The following opening phrases seem worn-out when appearing in piece-goods Western novels, but here they are almost perfect: "The steel-grey steady gaze tells you that this man will not give an inch. Six foot tall, slender—almost lean..." He is easily recognized in street life, striding along at an impressive pace, wearing a hat, an overcoat with flowing tails and a well-filled briefcase. One of the last indomitable pedestrians in the era of mass motorism (he owned a car in those days when that was a mark of distinction and still fun).

His sparsely equipped bachelor's lair houses a huge book collection (no TV set). His favourite reading seems to be history, politics and biographies, reflecting a deep social awareness and interest in individual fates, and also science, in particular natural sciences and their history.

At times Sverdrup disappears from town life. In case of emergency one can then with probable success write to Kalvetreet, N-5850 Balestrand. Here, in the West Country, is his cabin and second home, where he works and rests in solitude. Food is provided by fishing in

the sea and in lakes and creeks. His reports on the culinary pleasures of smoked salmon, boiled coalfish with melted butter, fish soups, etc., are most engaging. Then there is that cuttlefish in ink sauce . . .

He is a keen trout fisherman. In younger days he used to raom in the wilderness with a minimum of equipment: a fishing rod and a frying pan, often no hiking tent. A blend of the refined and the primitive.

It is hard to trace the caveman disposition in the everyday-life appearance of Sverdrup: attentive, correct—in official matters rather formal, usually wearing a suit (there must be at least two of them). Some signs of his character are the great demands he makes on himself, his total reliance on his own strength, and his insisting on complete personal responsibility. On closer acquaintance you meet a considerate colleague and friend—and a good mixer: a source of ideas and engagements, a gift for story-telling combined with observant listening, a good-natured sense of humour with no strain of mockery, and a smile which is a miraculous collection of horizontal wrinkles.

Inevitably Sverdrup created a tradition in actuarial and statistical science at the University of Oslo and in Norway. It is a historical circumstance that he was summoned to leadership in a young academic field, where individual achievements necessarily would be decisive. However, the results are entirely attributable to the strong efforts of this self-sacrificing organizer and honest scientist. Younger Norwegian statisticians, who have entered into a well established educational system and proceeded in a rich environment of statistical operations under stable social conditions in peace-time, must take off their hats to the remarkable person and career described here.

Acknowledgements

I am grateful to colleagues, pupils, and friends of Erling Sverdrup who have supported my work on this biographical note by providing background material and by commenting upon the first draft. My special thanks are due to Herdis Thoren Amundsen, Karl Henrik Borch, Anders Hald, Jan Michael Hoem, Tore Schweder, Jakob Sverdrup, and Howard Waters.

Writing contemporary history is not easy: the contemporaries are still there, and they may have different views. It is inevitable, I think, that in any piece of historical writing there will remain elements of subjectivity and personal flavour, and I am confident that it will be allowed for also this time. Anyway, scruples of this kind are completely outshined by the pleasure I took in drawing this portrait.

I take this opportunity to express my heartfelt thanks to all those who upon my solicitation prepared scientific contributions to the present volume. All papers were subjected to normal refereeing and editorial procedures in the *Scandinavian Journal of Statistics* or in the *Scandinavian Actuarial Journal*, and each paper presented here has previously been published in one of these journals. I deeply appreciate the cooperative attitude of my colleagues on the editorial boards of *SJS* and *SAJ* in these matters.

Some publications of Erling Sverdrup

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[2] *The cleaving of a univariate measurement into two factors.* Memo, 1948, Inst. of Econ., Univ. of Oslo. (Co-authored with Ragnar Frisch.)

[3] *En bekvem formulering av Cochrans teorem.* Memo., 1951, Inst. of Econ., Univ. of Oslo.

[4] *En randbemerkning om Cochrans teorem.* Memo., 1951, Inst. of Econ., Univ. of Oslo.

[5] *Om punktestimering av sannsynligheter på grunnlag av et tilfeldig utvalg.* Memo., 1951, Inst. of Econ., Univ. of Oslo.
[6] *How can we decide whether the Minimax Principle is good or bad?* Memo., 1952, Inst. of Econ., Univ. of Oslo.
[7] *Simultan testing av flere hypoteser.* Memo., 1952, Inst. of Econ., Univ. of Oslo.
[8] The limit distribution of a continuous function of random variables. *Skand. Aktuarietidskrift* **35** (1952), 1–10.
[9] Weight functions and minimax procedures in the theory of statistical inference. *Archiv for mathematik og naturvidenskab B.LI* **7** (1952).
[10] Basic concepts in life assurance mathematics. *Skand. Aktuarietidskrift* **35** (1952), 115–131.
[11] Similarity, unbiassedness, minimaxibility and admissibility of statistical test procedures. *Skand. Aktuarietidskrift* **36** (1953), 64–86.
[12] *Harmonisk analyse med normal erratisk komponent.* Memo., 1954, Inst. of Econ., Univ. of Oslo.
[13] *Scientific requirements in the actuarial profession.* Paper presented on the occasion of the Golden Jubilee of the Norwegian Society of Actuaries, 1954. Den Norske Aktuarforening.
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[23] *Limit theorems in probability theory. Notes to John Lamperti: Probability* (1966). Lecture notes, 1969, Inst. of Math., Univ. of Oslo.
[24] *Some basic concepts in the theory of stochastic processes.* Lecture notes, 1969, Inst. of Math., Univ. of Oslo.
[25] *Noen forsikringsmatematiske emner.* Stat. Memo. No. 1, 1969, Inst. of Math., Univ. of Oslo. (Revised 1976.)
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Mer paradox.

Jostein Lillestøl presenterte et "paradox" i TG 3-93, om at to hoder tenker like dårlig som ett. Han antok at de to finansanalytikerene hadde somme marginalfordelig på rett og gal beslutning, og at de vurderte uavhengige av hverandre.
Resultatet gjelder uansett uavhengighet eller avhengighet, og uansett vekting i loddtrekkingen en gjør om de er uenige, det er nok at de ha samme marginalfordelinger, som sees av følgende tabell

		Analytiker A		
		Rett	Galt	Marginal B
Analytiker	Rett	q	$p-q$	p
B	Galt	$p-q$	$1-2p+q$	$1-p$
	Marginal A	p	$1-p$	1

p er begges marginalsannsynlighet for rett beslutning, q er simultansannsynligheten for at begge har rett vurdering. (Lillestøl har $q=p*p$). Vi har at $q<p$ fordi sannsynligheten for at begge har rett ikke kan overstige sannsynligheten for at en har rett.
Anta Oppmannen ikke kaster mynt og kron ved uenighet, men bruker en sjev trekking (α og $1-\alpha$), dvs. han stoler mer på den ene enn den andre.

$P(\text{firmaet tar rett beslutning}) = q+ \alpha(p-q) + (1-\alpha)(p-q) = p.$

Med samme marginalfordeling kan altså to hoder aldri tenke bedre enn ett! Har du samme kunnskap så tilfører du ikke noe nytt. Ansett aldri to økonomer fra samme handelshøyskole!

Erik Mønness, Hedmark distriktshøgskole.

A 200-year-old probability theory could help to avoid some of the miscarriages of justice that embarrass the courts and have undermined public trust in the judicial system

Improving the odds on justice?

Robert Matthews

ALL over Britain, juries of ordinary people regularly listen to evidence in courts of law. It can be anything from a child's statement alleging ritual abuse to the probability of a DNA match. Somehow, the jury has to pull the evidence together, assess its relative merits and decide on the probability of guilt of the accused.

It is a notoriously difficult task. When mistakes are made, the results can be catastrophic. Yet few members of juries, barristers, or even judges realise that techniques designed to solve their age-old problem already exist. Earlier this week, the Royal Statistical Society met to discuss these techniques. Known collectively as Bayesian inference theory, they could revolutionise the way that juries reach their decision—and dramatically reduce the risk of miscarriages of justice.

The techniques are based on principles first published by Thomas Bayes, an 18th-century cleric, who worked out how new evidence can modify the odds for a particular hypothesis. Although they are now more than 200 years old, their importance for the law was highlighted last December by an important Court of Appeal case in which Bayesian inference theory helped secure a retrial of a convicted rapist.

In 1990, Andrew Deen was sentenced to 16 years in jail at Manchester Crown Court for raping three women. The main evidence linking Deen to the attacks was the allegedly close match between the DNA genetic fingerprint of samples found at the scene of the crimes and those from Deen. At the trial, the forensic scientist presenting the DNA and blood-typing evidence said that the match was so good that the probability of the samples having come from someone other than Deen was 1 in 3 000 000. In his summing up, the judge told the jury that so large a figure, if correct, "approximates pretty well to certainty".

Last December, the Court of Appeal quashed the conviction, declaring the verdict unsafe. In their ruling, the appeal judges made it clear that both the forensic scientist and the judge had fallen into a trap known as the "prosecutor's fallacy". At the heart of this fallacy is the meaning of the often very impressive probabilities generated by DNA techniques.

DNA evidence takes the form of bands produced by samples taken from the scene of crime and from the accused. The number of these bands that coincide in each sample is used to calculate a probability. But just what does this probability mean? It is the probability of getting as good a DNA match from a person plucked at random from the population. In other words, the evidence in the Deen case implied that there was only a 1 in 3 000 000 chance of getting so good a match from an innocent person unconnected with the crime.

Probable confusion

In the Deen case, however, the forensic scientist and the judge both confused this with the probability of Deen being innocent, given so good a match. These two probabilities may sound very similar, but Bayesian inference theory shows they are completely different.

In essence the theory as it relates to legal proceedings has two stages. The first stage involves calculating the value of the so-called likelihood ratio, a measure of the probabilities of getting specific evidence if the accused is innocent and if the accused is guilty (see "Bayes's theorem"). In the case of DNA evidence this ratio is usually large and could run into millions. The next stage is to multiply the probability of the suspect being guilty before the discovery of the new evidence by the likelihood ratio. The result is the new probability of guilt, given this evidence.



Therefore, to assess the evidence properly the jury would have needed to know the probability of Deen's guilt before the forensic evidence was given. If that prior probability of guilt was small—that is, if there is little other evidence to corroborate the forensic evidence—then even the impressive probabilities of genetic fingerprinting can be dramatically diminished.

In the latest issue of the *Journal of the Forensic Science Society*, researchers at the Institute of Environmental Health and Forensic Sciences in Auckland, New Zealand, use crime statistics to estimate typical prior probabilities. They find that even a DNA match with odds of millions to one can be cut down to final odds of innocence of just 3 to 1—leaving plenty of room for "reasonable doubt".

In their paper to the Royal Statistical Society meeting, David Balding and Peter

Bayes's theorem

THE simplest form of the theorem is that the updated ("posterior") odds = likelihood ratio x prior odds where the prior odds are based on the pre-existing knowledge, and the likelihood ratio is extracted from the new evidence.

The likelihood ratio is the probability of getting as good a match given that the defendant is guilty, divided by the probability of a match if the defendant were innocent. As the guilty person is certain to give a match with the scene of crime sample, this first probability is 1.

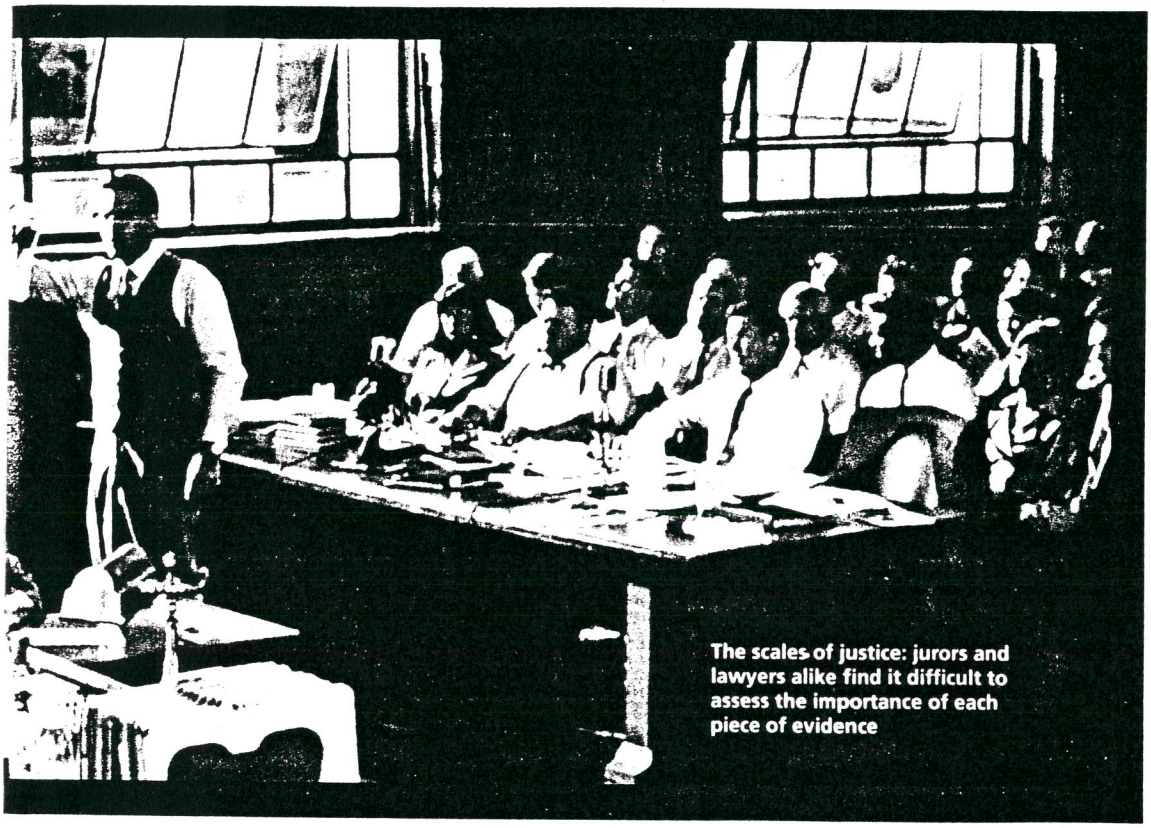
The second probability—of getting as good a match from someone unconnected with the crime—can, however, be very low if the match is very good, as it can be in the case of DNA fingerprinting.

Although this does make the likelihood ratio very large, if there is little corroborative evidence, even a likelihood ratio of millions can fail to amplify the odds of guilt beyond "reasonable doubt".

INSTITUTT FOR MATEMATISKE FAG
NORGES LANDBRUKSHØGSKOLE

Donnelly of Queen Mary and Westfield College, London, show that the prosecutor's fallacy is only one of many subtle traps waiting for those assessing DNA evidence. Balding points out, however, that the dangers reach far beyond this relatively recent technique for establishing guilt: "Evidence in the form of probabilities has been used in courts for years, but it's only now that people are beginning to ask about how to assess it all correctly."

Attempts to put the assessment of legal evidence on a rigorous footing are not new: the French mathematician Siméon Denis Poisson published a treatise on it in 1837. Its use in courts has, however, often been surrounded by controversy.



The scales of justice: jurors and lawyers alike find it difficult to assess the importance of each piece of evidence

Moviestore Collection

Almost a century ago, the French mathematician Jules Henri Poincaré used probability theory in an attempt to cast doubt on handwriting evidence used in the trial of Alfred Dreyfus. Unimpressed, the jury found Dreyfus guilty of treason—a miscarriage of justice, the repercussions of which can still be felt in France today.

Even so, many lawyers remain uneasy about the use of probability theory in court. Their concern is that juries may be seduced by the apparently unimpeachable authority of numbers and equations. But probability experts see the Deen case as a clear argument for both jurors and lawyers being made more familiar with the techniques for assessing evidence.

'The judge had fallen into a trap known as the prosecutor's fallacy'

"Even if they don't think about them consciously, they should have some feel for what questions they should be asking themselves," says Colin Howson, reader in logic at the London School of Economics, and co-author of a recent book on Bayesian reasoning (*Scientific reasoning: the Bayesian approach*). "I think they should be worked into all legal courses—not the full-blown abstract theory perhaps, but certainly the qualitative results it leads to."

The value of knowing the right questions to ask is well illustrated by confessional evidence. Bayesian analysis shows that a confession only increases the probability of guilt if the probability of obtaining a confession from the real perpetrator of the crime is higher than that of getting one from someone unconnected with it. In other words, if, having heard details of the police interrogation, jurors think an innocent person is just as likely to have cracked as someone who is guilty they are wrong to take the confession as contributing to the probability of guilt.

Bayesian analysis also shows that if there is little evidence apart from the confession, juries have to be convinced that the interrogation methods are far more likely to cause the guilty person to confess than someone who is innocent. It is difficult to see how this could ever be guaranteed, but only then will the prior probability of guilt be boosted "beyond reasonable doubt".

Bayesian analysis thus provides rigorous backing for the misgivings many people have about unsupported confessions. Clearly, such evidence should never be admissible in any legal system. Yet only after the notorious miscarriage of justice involving the Guildford Four have English courts been wary of such evidence.

'Even a DNA match with odds of millions to one can still leave room for reasonable doubt'

Bayesian analysis can reveal unsuspected pitfalls. Peter Urbach, reader in philosophy at the LSE, cites the example of so-called "similar fact" evidence, currently a hot topic among lawyers. Such evidence takes the form of two witnesses giving testimony of "striking similarity" concerning the guilt of the accused.

The Law Lords have argued that such evidence is relevant if the similarities go beyond what one might expect, and if there is only a small chance of getting such similarity from two witnesses concocting their stories separately.

Similar evidence

A Bayesian analysis shows that this is wrong on both counts. The evidence does not have to be "similar"—it can be dissimilar and still support a guilty verdict—and its relevance depends not just on the probability of getting both stories, but also on the probability of getting the first story—given that the accused may or may not be guilty. "Without doing the algebra, it is very difficult to think about these things abstractly," admits Urbach. "It's not at all surprising that lawyers come to the wrong conclusions."

While many lawyers accept the need to put the assessment of evidence on a firmer footing, some doubt whether juries will reach safer verdicts as a result. "Academic lawyers tend to talk about these things, but I never cease to be amazed by the decisions juries come to," says one leading criminal barrister. "You simply cannot tell what it is that is going to sway them."

Balding believes this underlines the need for speeding up the introduction of techniques for assessing evidence: "The fact is that you can't always reach the right conclusions using intuition alone. We have to tell juries the truth and help them to think properly about what they are being told."□

Robert Matthews *is science correspondent of* The Sunday Telegraph.

Bokanmeldelse

Bent Natvig og Tore Nordseth: **Sannsynlighetsregning.** Etterutdanningshefte. Tilvalgsstoff i 1MA. Aschehaug 1993.

Vi som underviser i begynnerkurser i statistikk på universiteter og høgskoler, har et stort handicap i forhold til våre kolleger matematikerne: Stort sett vet studentene ingenting om faget vårt på forhånd. Heldigvis begynner dette å bedre seg noe; det tas inn etterhvert noe stoff i sannsynlighetsregning og statistikk under matematikk-undervisningen i den videregående skolen. Dette heftet er ifølge omslaget beregnet til etterutdanning av lærere, pensum ved lærerhøgskoler, tilvalgsstoff for elever i 1MA, samt til idébank og repetisjon. Som tittelen sier, konsentrerer det seg om sannsynlighetsregningen.

På mange måter er sannsynlighetsregningen den mest utakknemlige delen av faget vårt å undervise i: Det blir ofte til en oppterping av terninger, kortspill og trekking av fargete kuler, og studenter og elever mister lett motivasjonen. Vi finner både kort, terninger og kuler i Natvig og Nordseth's hefte også, men mange gode virkemidler er tatt i bruk for å gjøre stoffet mer interessant: Aktuelle spill som lotto, rikstoto og tipping er benyttet i rikelig monn med realistiske bilder av kuponger som figurer. Historiske bemerkninger er med på å krydre stoffet. Ikke minst er bruken av aktuelle fornavn (Vegard, Bjørn og Vladimir....) i oppgavene morsom.

På ett punkt har imidlertid forfatterne blitt innhentet av uforutsette begivenheter når det gjelder disse navnene: Bruken av 'Johan Jørgen' sammen med andre politikernavn i oppgavene 1.8 og 5.3 er ikke lenger fullt så festlig. På mange måter er det smakløst av en bøkanmelder å trekke frem dette poenget, men når det først er gjort, er jeg fristet til å trekke det litt etter hårene: I de siste kapitlene i heftet anvendes sannsynlighetsregningen bl.a. på pålitelighetsanalyse-beregninger. Spørsmålet man ofte sitter igjen med etter slike regninger, er: Vil ikke de katastrofene som skje, ofte komme der man overhodet ikke venter dem på forhånd, kanskje man ikke tenker på muligheten engang?

Fra disse kjetterske tankene om sannsynlighetsregningen, la oss gå tilbake til heftet: Stoffet er fint og enkelt presentert, og utvalget av oppgaver er rikelig og illustrerende. Jeg har lyst til å trekke frem én oppgave: I oppgave 1.10 gis en enkel og klar fremstilling av Marilyn von Savant's TV-spill, som har skapt het debatt i mange akademiske miljøer, er tidligere (mars 1993) diskutert her i TG av Steinar Engen, og også i enda mer seriøse tidsskrifter (*American Statistician*, **45**, 284-289 (1991); **45**, 387-388 (1991); **47**, 82-83 (1993) osv.)

Av eksemplene i heftet kan nevnes brosystemet i Eksempel 7.5 med 5 komponenter: 1 + 4 i parallell med 2 + 5 og med komponent 3 som en bro mellom de to delene. I heftet blir sannsynligheten for at et slikt system skal funksjonere, beregnet relativt enkelt ved først å betinge med hensyn på om komponent 3 funksjonerer eller ikke. Jeg skulle imidlertid gjerne se den gymnasiasten som ville klare en slik oppgave uten å få noe hint!

For de sterkeste elevene tror jeg dette hefte vil virke både motiverende og stimulerende, og jeg tror mange vil føle at de finner mye interessant. Jeg er redd endel svake elever vil få vanskeligheter med den uunngåelig tunge notasjonen som sannsynlighetsregningen ofte fører med seg. Ellers er det vanskelig å si hvordan å si hvordan et slikt hefte vil virke i praksis uten å ha eksponert elever i den akteuelle gruppen for det.

Et lite kritisk punkt til slutt: Både på omslagssiden og i forordet snakkes det om hvor viktig det for eksempel er i politikken å kunne vurdere risiko og gjøre riktige valg. Det finnes noen få eksempler og oppgaver i heftet som kan knyttes opp mot denne alvorlige motivasjonen, men de har ikke noen særlig fremtredende plass.

I alt, imidlertid: Heftet anbefales!

Inge Helland

SPRUCE III
M E R I D A

Merida, Yucatan, Mexico
December 11 - 15, 1995

Statistics in Public Resources, Utilities, and in Care of the Environment

Guanajuato, Gto. May 12, 1994

Editor
Norwegian Statistical Society
c/o Department of Mathematics,
University of Bergen, Allégaten 55, N.
5007 , Bergen, NORUEGA

Dear Editor,

I would greatly appreciate it you would include the following information in your International Calendar of Statistical Events:

December 11-15, 1995: Merida, Yucatan, Mexico. Third SPRUCE Conference (Statistics in Public Resources, Utilities, and in Care of the Environment). [V. Pérez-Abreu, CIMAT, Apdo. Postal 402, Guanajuato, Gto. 36000, México. FAX (52-473) 25749, SPRUCE@CONACYT.MAIN.CONACYT.MX]

Sincerely yours,

Víctor Pérez-Abreu
Local Organiser
pabreu@conacyt.main.conacyt.mx

NYTT FRA UNIVERSITETET I OSLO

Uteksaminert cand. scient.

Staale Bergland: "Gjeninnsettelsessystemet - alternativ motorvognforsikring." Veileder: Walther Neuhaus

Statistical Research Reports.

Geir Storvik: A Bayesian Approach to Dynamic Contours through Stochastic Samling and Simulated Annealing. No. 1, 1994.

Nils Lid Hjort og Ingrid Glad: Nonparametric Density Estimation With a Parametric Start. No. 2, 1994.

Nils Lid Hjort: Dynamic Likelihood Hasard Rate Estimation. No. 3, 1994.

Nils Lid Hjort: Bayesian Approaches to Non- and Semiparametric Density Estimation. No. 4, 1994.

Erik Bølviken og Eva Skovlund: Confidence intervals from Monte Carlo tests. No. 5, 1994.

NYTT FRA UNIVERSITETET I BERGEN

Uteksaminert cand. scient.

Ki Hyun Park: "Parametric estimation of ruin probabilities."
Veileder: Jostein Paulsen

Jamshain Iqbal: "Estimation of probabilities of misclassification in discriminant analysis."
Veileder: Trygve Nilsen

Dr. scient.

Hans Julius Skaug disputerte 2. juni 1994 med avhandlingen:
"Nonparametric functional estimation with application to hypothesis testing."
Komite: 1 Professor Peter Robinson, London School of Economics
2 Docent Markku Rahiala, University of Oulu
Veileder: Dag Tjøstheim

Førsteamanuensis **Jostein Paulsen** tilbringer vårsemestret
ved Department of Statistics, University of California, Berkeley.

NYTT FRA GRUPPE FOR STATISTIKK, NTH

Ferdige sivilingeniører

Tove Andersen: *'Dimensionality selection in regression'*. Veileder: Thore Egeland, Norsk Regnesentral, Oslo. (Faglærer ved NTH: Bo Lindqvist)

Sigrunn Hansen: *'Prediksjon i stokastiske felt med ikke-homogen varians'*. Veileder: Henning Omre.

Geir Johansen: *'Simulation algorithms for gaussian related random functions'*. Veileder: Henning Omre.

Randi Jule: *'Statistisk analyse av levetidsdata med programpakken S-PLUS. Anvendelse på feildata fra sikkerhetsventiler i oje- og gassbrønner'*. Veileder: Bo Lindqvist.

Lars Edward Kjellesvik: *'Stochastic description of reservoir characteristics conditioned on seismic data'*. Veileder: Henning Omre.

Geir Arne Kjønstad: *'Selected determinants for all-cause mortality among 2242 diabetics: a follow-up study after The Nord-Trøndelag Health Survey 1984-86'*. Veileder: Øystein Krüger, Folkehelsa, Verdal/Samfunnsmedisinsk institutt, UNIT. (Faglærer ved NTH: Bo Lindqvist).

Jan Terje Kvaløy: *'Analysis of repairable systems: Trend-testing'*. Veileder: Bo Lindqvist.

Morten Lien: *'Bruk av tidsrekker ved analyse av reparerbare systemer'*. Veileder: Per Hokstad.

Nils Meland: *'Regression with censored response – Analysis of coagulation time of blood'*. Veiledere: Poul Thyregod og Helle Holst, Danmarks Tekniske Høgskole. (Faglærer ved NTH: Bo Lindqvist).

Ola-Petter Munkvold: *'Bootstrapping og estimering av forventet ekstremverdi'*. Veileder: Fred Godtliebsen.

Simen Normann: *'Enhancing SAR images by modern statistical and geometrical methods'*. Veileder: Fred Godtliebsen.

Jan Gerhard Norstrøm: *'Bayesian analysis and decision theory in reliability and risk analysis'*. Veileder: Henrik Kortner, Norsk Hydro, Forskningsavdelingen, Porsgrunn. (Faglærer ved NTH: Per Hokstad).

Pål Marius Rødseth: *'Hazop and environmental risk analysis'*. Veileder: Stian Lydersen.

Inger-Anne F. Sætermo: *'Target characterization : A comparizon between diffraction tomography and maximum likelihood estimation'*. Veileder: Leiv-J Gelius, Norwave Development A/S, Oslo. (Faglærer ved NTH: Fred Godtliebsen)

Jan Frode Saasen: *'Using software metrics to manage software quality'*. Veileder: Stein B. Jensen.

Inger Maren Tveit: *'Sammenkobling av ekspertvurderinger og data i pålitelighetsanalyse'*. Veileder: Olav Bakken, DnV Technica, Høvik. (Faglærer ved NTH: Bo Lindqvist).

Are Willersrud: *'Restoration of curves disturbed by outliers and noise'*. Veileder: Fred Godtliebsen.

Høylands dag

Torsdag 10. mars arrangerte statistikkgruppen seminar og middag til ære for ekteparet Høyland. Arrangementene hadde rundt 75 deltakere. Statistikere fra hele landet (og utlandet) deltok, og både yngre og mer etablerte statistikere hadde tatt veien til Trondheim og NTH denne dagen.

Foredragsholdere ved seminaret var:

Bo Bergman, Linköping: *Statistikens roll inom offensiv kvalitetsutveckling.*

Marvin Rausand, NTH: *RCM – Reliability centered maintenance.*

Bent Natvig, UiO: *Noen aspekter ved pålitelighetsanalyse i sjokk-modeller.*

Kjell Doksum, Berkeley: *Degraderingsprosesser.*

John Tyssedal, NTH: *Verdet av gode forsøksplanar.*

Steinar Engen, AVH: *Dynamiske modeller for biologisk mangfold.*

Statistisk Forening Trondheim

Foreningen har hatt to møter våren 1994:

Tirsdag 8. mars med foredrag av professor Kjell Doksum, University of California, Berkeley: *Om kvantiler og kvantil-prosesser.*

Onsdag 18. mai med foredrag av forsker Øystein Krüger, Institutt for samfunnsmedisinske fag, UNIT og Samfunnsmedisinsk Forskningssenter, Verdal: *Helseundersøkelsen i Nord-Trøndelag – Ny arena for statistikermiljøet i Trondheim?*

Medlemskap i Norsk Statistisk Forening

Kontigenten i foreningen er på kr. 150 pr. år (kr. 90 for 1993) for regulære medlemmer og kr. 50 for studenter (kr. 30 for 1993). Korrespondanse om medlemskap og innbetaling av kontigent skal skje til foreningens kasserer:

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Nye medlemmer melder seg til kassereren under adressen oppgitt ovenfor. Slike medlemmer får automatisk tilsendt Tilfeldig Gang, med forbehold om at det tar noe tid før tilføyelser og forandringer i medlemsregisteret gjenspeiler seg i adressesedlene til bladet. Adresseforandringer meldes også til kassereren. Ved utsendelsen av Tilfeldig Gang benyttes det kopier av det vanlige medlemsregisteret, så adresseforandringer behøver ikke meldes separat til bladet.

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Bidrag til Tilfeldig Gang

Neste nummer av Tilfeldig Gang vil forhåpentligvis komme ut i september 1994. Alle slags bidrag til bladet er velkommen, enten det gjelder nye temaer av interesse for norske statistikere, eller man har kommentarer til innlegg som allerede har stått i bladet. Stoff til neste nummer må være redaktørene i hende senest 1. september 1994.

Adressen til redaktørene er:

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