EXPANDING HORIZONS
NEWSLETTER OF THE EDUCATION AND RESEARCH SECTION

NUMBER 18 JULY 1998

Musings from Margie

by Marjorie A. Rosenberg

Our lead story in this issue concerns the development of a new actuarial program in Australia by Mike Sherris. In addition, this issue contains two articles reflecting the research side of our business. One by Irwin Vanderhoof discusses the process of doing a research study on Lyme disease, while the other by Dale Borowiak proposes upper and lower bounds in the estimation of single-decrement rates.

In addition to the announcements, there is a letter from Jim Daniel of the University of Texas at Austin responding to the article by Christiansen and Klugman about academic involvement. Comments from our readers are strongly encouraged and will be used by the Section Council to help formulate our response and future direction. Please e-mail me at mrosenberg@ bus.wisc.edu.

Marjorie A. Rosenberg, FSA, Ph.D., is Assistant Professor in the School of Business and the Department of Biostatistics and Medical Informatics, University of Wisconsin, Madison and Editor of Expanding Horizons.

Developing a New Actuarial Program

by Michael Sherris

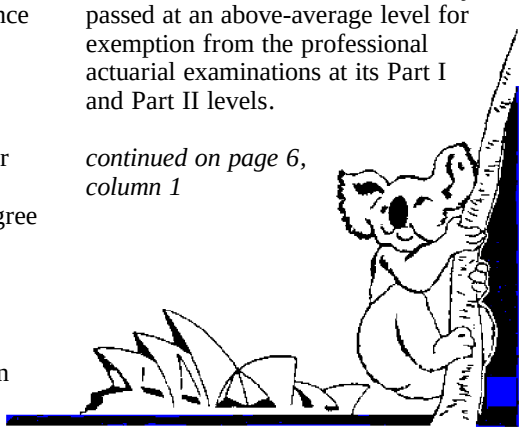
In January 1998 I was appointed to the Faculty of Commerce and Economics at the University of New South Wales (UNSW) in Sydney, Australia to establish a new actuarial studies program. This article outlines the program and discusses some of the issues considered when establishing the actuarial studies program. My experience will hopefully be of interest to academics and others interested in actuarial education.

At the very start, the aim was to develop a program that integrated finance and insurance and emphasized risk, finance, and financial modeling. The program also needed to be relevant for the needs of industry, to provide a foundation for students wishing to enter the quantitative areas of finance and insurance, and to encourage higher degree study.

Actuarial Education in Australia

In Australia, the university programs in actuarial studies are offered as commerce degrees. Students entering the university undergraduate actuarial programs are required to have a strong background in mathematics as well as to be in the top 5% to 8% of high school students in Australia. In the past, programs have been offered at Macquarie University, the University of Melbourne, and the Australian National University. Actuarial education in Australia is very heavily dependent on the university programs because the Institute of Actuaries of Australia accredits subjects passed at an above-average level for exemption from the professional actuarial examinations at its Part I and Part II levels.

continued on page 6, column 1



In This Issue

Chairperson's Corner

by Curtis Huntington

As a follow-up to the "Symposium of Actuarial Relationships with Academia" mentioned in the last issue, we invited SOA President-elect Howard Bolnick to meet with the Section Council at our April 29 meeting in Chicago. We had a wide-ranging discussion with Bolnick and committed the Section Council to fully support his efforts to expand ties between the actuarial profession and academia.

One outgrowth of the symposium has been the organization of a Joint Task Force on Academic Ties, with representatives from the SOA, the Canadian Institute of Actuaries, the Casualty Actuarial Society, and the Australian Institute of Actuaries. We explored with Bolnick possible ways of interacting with this Task Force and pledged our full support and cooperation with the Task Force.

As a second follow-up, the Council also agreed to formally develop an on-line e-mail group (moderated list server). In the next 18 months, we expect to see rapid developments as the SOA and CAS finalize their educational and examination changes. It will be critical to release timely information to the academics as we prepare for implementation of the new syllabus on January 1, 2000.

As to new issues, I recently attended a meeting of the Council of Section Chairpersons and have some information about the Section that I thought readers might find to be of interest.

In size, the E&R Section is the second smallest of the 13 Sections, with a membership of 747. (Only the Smaller Insurance Company Section, with 726 members, is smaller.) Personally, I don't find this surprising given the current state of the profession's relationships with both its academics as well as its approach to basic research.

A breakdown of the membership finds that 45% of members are ASAs and 71% of members are residents of the U.S. This closely follows the profile of the other Sections. Almost 14% of the Section membership identifies their business affiliation in the category of "University or College." In other Sections, the business affiliation of "University or College" ranges from a "high" of 1.48% of the International Section to a more typical percentage of less than 1% in the other Sections.

Within the E&R Section, 47% of members are from insurance companies and 26% from consulting firms. No other business affiliation category, except unaffiliated at 3.6%, has more than 15 members. I think these numbers reflect the special reasons why the Section exists and, to a large extent, where our focus has been.

As to our financial situation, our current Section balance is $9,839 after receiving most of the 1998 dues from our renewing members. As most of you will have recognized, we raised our Section dues from $10 to $15 in 1998. That increase reflects increasing Section-generated administrative costs being charged to the Section by the SOA. Even so, the Section's fund balance as a ratio to collected dues is now just 109%, the lowest ratio of any of the 13 Sections. For the past two years, our balances had fallen below 100% (the only Section below the 100% level) and had been a source of some concern to the Council and to the SOA.

Although our membership count is 32 members lower than last year, many of the Sections decreased in members this past year. I am sure that some part of our loss can be accounted for by the dues increase. While we regret any decrease in members, we believe the dues increase will allow the Section to continue to fulfill its mandate.

Our two ongoing functions are the production of this newsletter and the development of program content for the Spring and Annual Meetings. We actively participate in the program development and then recruit speakers for the sessions that are scheduled. As one of the smaller Sections, we frequently jointly sponsor sessions. As you look through the programs for the Hawaii meetings and the Annual Meeting in October in New York City, look for the sessions being sponsored by your Section—I think you will find the topics to be wide-ranging and quite stimulating.

One new activity that the Council has started to explore is the development of a speaker's kit to be used by university actuarial clubs in making presentations to local high schools. These presentations are designed to present the actuarial profession to high school

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475 N. Martingale Road, Suite 800
Phone: 847–706–3500, Fax: 847–706–3599
World Wide Web: http://www.soa.org

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This newsletter is free to Section members. A subscription is $5.00 for nonmembers. Current-year issues are available from the Communications Department. Back issues of *Expanding Horizons* have been placed in the Society library. Photocopies of back issues can be requested for a nominal fee.

The Section would like to encourage articles and papers on education and research topics or subjects of interest to education and research actuaries. If you have an article or an idea for an article that you think might interest Section members, please contact the editor:

Marjorie Rosenberg, Editor
University of Wisconsin–Madison
School of Business
Grainger Hall
975 University Avenue
Madison, WI 53706–1323
Phone: (608) 262–1683; Fax: (608) 263–3142
E-mail: mrosenberg@bus.wisc.edu

continued on page 3, column 2

Chairperson's Corner
continued from page 2

students (and, maybe even more importantly, to high school teachers and counselors). They also provide the university students (usually juniors and seniors) an opportunity to develop their presentation skills.

At the University of Michigan, we have created several opportunities for our students to deliver such presentations and have had very positive feedback from all participants. We will be looking at other such programs to determine whether we can develop a package that can be used in a variety of situations. We anticipate actively involving actuarial clubs around the country to set up local visits.

On the research side, you will note that Margie Rosenberg has assembled an issue of *Expanding Horizons* with a couple of articles targeted to the research component of our mandate. For a long time, we have realized that a number of you joined this Section because of your interest in research (as compared with education), and we want to serve you as well. I commend the various articles to you and would be interested in your reactions to this issue.

In that regard, your attention is called to the upcoming Actuarial Research Conference being held at Georgia State University in Atlanta on August 6–8, 1998. Always well attended by academics, we are encouraging more industry professionals interested in research to attend the conference this year. A wide exchange of research interests and problems can only enhance our service to the profession.

Finally, you will have recently received ballots for Section elections, as well as for the SOA Board elections. Voter turnout has been declining in recent years, and this is a cause of some concern. Please take a few minutes of your time to vote for the leadership of your Section and of your Society. We need to ensure that your interests are adequately represented in both groups, and you can do your part by taking an active part and voting.

Curtis E. Huntington, FSA, is a Professor at the University of Michigan in Ann Arbor, Michigan and Chairperson of the Education and Research Section Council.

An Actuarial Analysis of Lyme Disease

by Irwin T. Vanderhoof

Because of infections in my own family, I have a special interest in Lyme disease. When the Society of Actuaries agreed to provide some funding to the Lyme Disease Foundation to help develop a database for Lyme disease patients, I was interested in seeing what an actuarial approach to this information might reveal. The entire effort can then be looked at as an experiment in the actuarial approach to analysis of disease as well as an attempt to use an actuarial background to find information useful in the understanding and treatment of the disease.

As most people now realize, Lyme disease is usually transmitted by the bite of a tick. The very small deer tick is most frequently implicated, but other kinds of ticks and insects also seem to be able to transmit the disease. The early symptoms are similar to those of summer flu—fever, aches, and general malaise. If treated early, the prognosis is usually a quick resolution of symptoms as part of a complete recovery. If treatment is delayed, some cases will become deep-seated and a cure is not always possible.

"The Lyme Disease Foundation developed a questionnaire that was distributed to various Lyme disease support groups and physicians who have a significant number of Lyme disease patients."

The Lyme Disease Foundation developed a questionnaire that was distributed to various Lyme disease support groups and physicians who have a significant number of Lyme disease patients. Self-selection was involved in that a high proportion of the intractable cases would be expected to attend support group meetings or have been treated by the few physicians who will attempt treatment and cure of such cases. The cases reported were then the more difficult ones. The questionnaire includes a variety of questions concerning the recollection of a tick bite, the presence of the characteristic rash, the results of various blood tests, the number of physicians seen before a diagnosis was received, and the various treatments that were used in attempting a cure.

The questionnaire also includes 55 symptom queries. Some of the questions include rating the frequency and severity of each symptom on a scale of 1 to 5. The symptoms include extreme fatigue, headaches, recurring fevers, a wide variety of musculoskeletal pains and neurological problems, heart problems, gastric problems, eye and ear problems, and a few more skin complications besides the rash. The problem with Lyme disease is that there are so very many different symptoms and so many of them are common to other diseases. The questions also include a request for information concerning the costs of Lyme disease in terms of the loss of income and nonfinancial costs, as well as the costs of finding a physician who would treat the disease as well as the costs of such treatments both before and after diagnosis.

The information was fed into a Paradox database and the question then became what to do with the data. Some steps seemed obvious. Multiplication of the frequency and the severity of the symptoms gave one variable per symptom. This one variable could then be characterized. If the ranges for each symptom were 1 to 5 with "5" meaning continuous discomfort or excruciating pain, then a product of more than 15 would mean something that we would expect to be reported to a physician in any examination. Of course there would be differences in perceptions of discomfort, but we had a database of

continued on page 4, column 1

Lyme Disease
continued from page 3

1,132 entries of which 771 had been diagnosed with the disease. (Individuals who did not have any known illness were encouraged to fill out the form to make up a control group.)

Usually in medical studies a special effort is made to establish that the group being tested constitutes a good sample for the tests. It would generally be desirable for a group of patients to be homogeneous as to tests, symptoms, and so on. We did not have that luxury, but we did have the advantage of a reasonable size sample. Medical literature is full of examples of conclusions being drawn from very carefully controlled groups numbering less than 20 or 50. In this case we had a large enough group that some reasonable conclusions could be drawn even though the data were not carefully selected.

An article, "Lyme Disease: The Cost to Society," was published that focused on costs of search for a diagnosis and treatment of the condition (*Contingencies*, Jan.–Feb. 1993, pp. 42–48, Karen Vanderhoof-Forschner and Irwin T. Vanderhoof).

"Usually in medical studies a special effort is made to establish that the group being tested constitutes a good sample for the tests. ... We did not have that luxury, ..."

Another possibility would be simply to display the patterns of symptoms for different groups (males versus female, New Jersey versus Connecticut or New York), the medical specialty of the physician who made the diagnosis, those diagnoses based on symptoms alone versus those diagnoses based on symptoms and blood tests, and so on. Such displays were presented at medical meetings on Lyme disease, but pure description would not provide any "statistical cover" for an attempt to make some generalization about the sample and therefore the impact of the disease. A simple categorization of the sample provided some interesting information. Females outnumbered males by about 3 to 1. The characteristic rash was observed in only 405 of the cases (most studies report a rate of about 60%). Though the disease is reportable in every state, only about one-third believe that their case was reported. Of the respondents, 694 had blood tests, of which 104 had only negative results and 382 had both positive and negative tests. On average, the patients needed five physicians and 21 months before a diagnosis was made. One artificial intelligence specialist used the database to try to determine the characteristics of those who became totally symptom free (the best indicator seemed to be the presence of a rash), which would usually lead to earlier diagnosis and treatment.

While this seemed an interesting approach, there were still problems. We had not asked any question about swelling of joints, which is one distinguishing characteristic of the disease. We could do a follow-up, but could we show that those who answered the additional questionnaire were not a biased sample of the total? A return of more than 10% might be considered acceptable, but the disease is highly politicized and important medical persons would criticize a conclusion based on such possibly biased information. The same problem could arise with regard to any suspect subgroup.

I had taken a course in multivariate analysis 15 years ago and believed that such techniques would provide a possible solution to this problem. My old texts on the subject seemed hopelessly out-of-date, and my quantitative friends did not have high recommendations for anything new. I haunted technical bookstores until I found one text that seemed comprehensive as well as easy enough for me to understand.

The Hotelling T^2 test seemed appropriate for this problem. It is the multidimensional analogue for the student *t*-test and translates into a value for the *F* distribution to allow a calculation of significance probability. The derivation of the test is based on an assumption of multivariate normality, and this assumption is obviously violated. However, the test is also regarded as "robust" with respect to these violations. There were three arguments for relying upon this characteristic of "robustness."

A first argument was invocation of the multivariate central limit theorem—we had 55 variables and hundreds of cases. Surely they would all come out to normal distributions. (For a test based on several different distributions see "Multivariate Statistical Inference and Applications," Alvin C. Rencher, Wiley, 1998.)

The second argument was more specific. If we change the problem by using the logs of the variables, do we get different answers? The answer is no.

Finally, the ultimate argument was that there were no close calls. If the conventional requirement for statistical significance is that there be less that a 5% chance that the two samples are the same and our answers are 0.2% or less or 40% or more, then the theoretical problems would not seem to bring the results into question. Multivariate analysis is often used in biological research but rarely in medical research. In this case we have 55 characteristics of each element in terms of the exhibited symptoms. Each of these could be considered an unreliable indicator of the disease, but when taken as a group they would be more formidable. It would seem that if two groups are not differentiated by the T^2, we should be able to argue that the results of one can be applied to the other. At worst we can say that if we have a follow-up survey that is answered by 30% of the original group and we can show that the pattern of symptoms is the same for those who answered as well as those who did not, then we have some evidence against a bias in response. The same kind of test and argument also worked for the comparison of the questionnaires filled out in physicians' offices and those completed in support group meetings. We have done as much as possible to weed out possible bias in subgroups.

The results of these studies have been well received in the medical community. Many of the physicians like the idea that some business people and quantitative persons are interested in the actual medical practice. They believe that they know what patients need but are unable to get a sympathetic hearing from the business people who now run the HMOs. The physicians would like researchers who are interested in the actual problems of cure, as well as

continued on page 5, column 1

Funds Available

The Finance Research Committee of the Finance Practice Area has funds available for researchers and welcomes proposals dealing with any area of finance or investments and the impact on the actuarial profession. Grants of up to $10,000 are available. Proposals with larger budgets can be considered with joint sponsorship [that is, the finance area and another Section (Investment, Financial Reporting), two practice areas, or with CKER]. However, applicants should be aware that other practice areas or Sections may not currently have funds available.

Grants have been given for the following types of research:

- Modeling conference (in conjunction with the Ed Lew Award)
- Papers on the 100-year term structure
- Value at risk
- Currency risk.

A study on the use of derivatives in the insurance industry was commissioned. Currently there is a grant outstanding to write a textbook on stochastic calculus that will be readable by actuaries whose statistical background is limited to that in the current educational syllabus.

The following areas should be covered in the proposal:

I. Description of Project
   A. Goal of Research
      1. Scope of proposed work
      2. Researchers who will be used, individuals or a team
      3. Approach planned
      4. Proposed time frame
      5. Where results will be published
   B. Actuarial impact
      1. Potential customers for results
      2. Potential uses of results
   C. How It Relates to the Finance Practice Area.

II. Proposed Peer Reviewers to Form Project Oversight Group (POG) and Suggestions for Chair

III. Proposed Budget
   A. Cost of data
   B. Cost of researchers' time
   C. Other expenses—if, for example, related to a conference
   D. Will staff resources be needed? If so, attempt to estimate time required.

Completed applications should be submitted to:

Zain Mohey-Deen
Research Actuary
Finance Practice Area
Society of Actuaries
475 N. Martingale Rd., Suite 800
Schaumburg, IL 60173–2226

Lyme Disease
continued from page 4

those of cost, to work with their problems.

Some specific results follow. We have good evidence that prompt treatment is the best way to reduce costs because of the major medical costs of those whose cases have become intractable because of late care. We also have found that Lyme disease seems a significant risk factor in pregnancy—a fact not previously recorded. This latter item appeared in a random investigation of material previously reviewed by others. Again we used the T^2 to show that those who were pregnant had the same pattern of symptoms as the remainder. Therefore, we argue, the results should apply to all women. We are continuing the studies. Additional questionnaires are still being received, and we have some funding to cover data entry. I am not sure how far we can go in this field, but I believe that actuaries can make a significant contribution to health care, besides simply adding up and allocating the costs.

Irwin T. Vanderhoof, FSA, is a clinical professor at the Stern School, New York University, in New York, New York and a member of the Education and Research Section Council.

Developing a New Actuarial Program
continued from page 1

Qualification as an Associate of the Institute of Actuaries of Australia (AIAA) is attained upon completion of the subjects in Parts I and II. Part I is the Australian equivalent of the new U.K. syllabus for the subjects 101 to 109. Part II is the "Actuarial Control Cycle," which is best described as two subjects covering actuarial principles and actuarial practice.

Qualification as a Fellow of the Institute of Actuaries of Australia (FIAA) requires the completion of subjects in Parts I, II, and III of the professional examinations. Part III is the exam for practice area subjects. No university exemptions are available from the Part III examinations. Two subjects are completed by distance education through the IAA, usually on a part-time basis, after completing the Part I and Part II subjects. Students select these two subjects from the five practice area subjects of Investment Management, Life Insurance, General Insurance, Superannuation, and Finance.

Accreditation of the university actuarial subjects requires above-average performance by students in the relevant subjects, relevant actuarial qualifications of staff teaching for the core actuarial subjects, coverage of the professional syllabus, and appropriate examination and assessment standards.

Fellowship of the Institute of Actuaries of Australia (FIAA) is recognized by local actuarial societies in Hong Kong, Singapore, Malaysia, New Zealand, and Japan.

The University of New South Wales (UNSW)

UNSW began its first courses in 1948 and now has a distinguished reputation worldwide. It has attracted many international scholars to its ranks and is in the Australian government's top group of Australian universities ranked by excellence. In 1996 the university was granted "The Australian University of the Year" award by the *Good Universities Guide*. UNSW is one of Australia's largest international universities. It has almost 29,000 students and more than 5,000 staff. Of the students currently on campus, more than 4,200 come from countries other than Australia. Many thousands of international students have attended the university over the past 40 years. It is also the home of the Australian Graduate School of Management.

At the undergraduate level, the Faculty of Commerce and Economics offers the the Bachelor of Economics and the Bachelor of Commerce (Marketing and Hospitality Management) degrees. It is possible to combine the Bachelor of Commerce majoring in finance with a specialized Bachelor of Science degree in mathematics. The Bachelor of Commerce allows students to major or double- major from a range of disciplines. In addition, students can take courses in those disciplines. Disciplinary studies are offered in accounting, business economics, business law and taxation, business statistics (econometrics), economic history, finance, information systems, industrial relations, international business, human resource management, Japanese and Korean studies, and marketing.

At the graduate level, the Faculty offers the Master of Commerce, the Master of Information Management, and a Graduate Diploma in Commerce, all of which are directed towards the development of professional and management skills through study of the major disciplines of the Faculty. In addition, the Faculty has strong research training programs leading to either the Master of Commerce (Honors), Master of Archive Administration, Master of Information Studies, or the Doctor of Philosophy. Recent initiatives by the Faculty include offering a Master of Commerce in Guangzhou, China.

There are strong links, both in teaching and research, among the Faculty of Commerce and Economics and the Faculty of Science and Technology, the Faculty of Engineering, and the Australian Graduate School of Management.

Actuarial Studies at UNSW

Initially, the actuarial studies disciplinary stream will be offered as a single major, double major, or minor in the Bachelor of Commerce. Entry into the Bachelor of Commerce is competitive, and the quality of students is high compared with many other Sydney-based universities. UNSW attracts more than 52% of the top 1,000 high school students in New South Wales.

The Bachelor of Commerce was designed to allow students to combine a major in one area with a major or minor in a broad range of other disciplines including accounting, banking, finance, economics, international business, business law and taxation, information systems, marketing, and industrial relations.

It is expected that double majors, or a major and a minor, in actuarial studies and finance, business economics, or business statistics will be popular choices. However, another objective of the program is to encourage actuarial majors to broaden their skills by studying minors in business law and taxation, international business, information systems, marketing, or industrial relations.

Students also complete a General Education Program consisting of subjects other than those in their professional or major disciplinary specialization. More than 250 subjects are offered in the General Education program, such as Business Ethics; Critical Thinking and Practical Reasoning; Student Learning, Thinking and Problem Solving; History of Mathematics; Risk Perception; and Reality.

To satisfy Bachelor of Commerce requirements, students must complete 24 units including six core units. Students must include in their degree program:

- Either a major of at least eight units in an approved disciplinary stream and a minor of at least four approved units of which no more than two may be first-year units
- A double major of 14 units, consisting of at least seven units in each of two approved disciplinary streams.

Under these major requirements, students need not complete all the subjects equivalent to the Institute of Actuaries of Australia Part I syllabus, but most students are expected to do so. The recommended program of study for students planning to qualify as actuaries will include all these subjects. This does, however, mean that students will in the future have the flexibility to cover some of the actuarial subjects as

continued on page 7, column 1

Developing a New Actuarial Program
continued from page 6

part of a graduate program when these are introduced into the Master of Commerce.

A program of study that illustrates the main subjects for an actuarial major is outlined below.

Year 1

- Accounting and Financial Management 1A (ACCT1501)
- Accounting and Financial Management 1B (ACCT1511)
- Microeconomics 1 (ECON1101)
- Macroeconomics 1 (ECON1102)
- Higher Mathematics 1A (MATH1141)
- Higher Mathematics IB (MATH1241)
- Actuarial Studies and Commerce (ACTL1001)
- One elective unit—a computing subject selected from a wide range of alternatives.

Year 2

- Financial Mathematics (ACTL2001)
- Probability and Statistics for Actuaries (ACTL2002)
- Stochastic Models for Actuarial Applications (ACTL2003)
- Five elective units—including Business Finance (FINS2613), Accounting and Financial Management 2B (ACCT2542), and Microeconomics 2 (ECON2101).

Year 3

Units selected must satisfy requirements for a major and a minor or a double major and satisfy general education requirements. Actuarial disciplinary stream units are selected from:

- Actuarial Statistics (ACTL3001)
- Life Insurance and Superannuation Models (ACTL3002)
- Insurance Risk Models (ACTL3003)
- Financial Economics for Insurance and Superannuation (ACTL3004)
- Risk and Insurance (FINS3631)
- International Insurance (FINS3651).

Students will include all four ACTL units in Year 3 to cover all the Part I actuarial professional subjects. If necessary, an additional "voluntary" subject can be completed in Year 3, which may be the case for students wishing to complete double majors and all the Part I subjects.

The disciplinary stream in actuarial studies was specifically designed to cover the new syllabus of the Institute of Actuaries to be introduced in 1999/ 2000. The list of subjects in Table 1 provides the subject equivalents for the professional examinations.

The complete list of subjects approved for the actuarial studies disciplinary stream also includes subjects in banking and finance, economics, and economic statistics (econometrics). Examples are Applied Corporate Finance (FINS3625), Bank Financial Management (FINS3630), Options, Futures and Risk Management (FINS3635), Interest Rate Risk Management (FINS3636), Mathematical Methods in Economics (ECON3202), and Econometric Theory (ECON3203).

Actuarial studies has the teaching support of the School of Accounting, School of Economics, School of Banking and Finance in the Faculty of Commerce and Economics, and School of Mathematics in the Faculty of Science and Technology. Actuarial staff will be appointed to commence teaching both Year 1 and Year 2 subjects in 1999.

Working with Industry

It was important to make the program relevant to industry. Discussions with major actuarial employers and potential employers took place to ascertain their needs and to explore ways in which they could be involved in the development of the program. Apart from competency in the technical actuarial skills, all these employers required graduates with good communication skills and business awareness.

Many of the additional skills required by employers could best be developed with work experience. UNSW has a successful co-op program and employers were very enthusiastic about an actuarial studies co-op program. In this program, the UNSW and major employers in the financial services industry link together to develop undergraduate

continued on page 8, column 1

TABLE 1
Institute of Actuaries Exemption Subjects

PART I		
• Subject 101	• Statistical Modeling	• ACTL2002 or MATH2801 and MATH22831
• Subject 102	• Financial Mathematics	• ACTL2001
• Subject 103	• Stochastic Modeling	• ACTL2003
• Subject 104	• Survival Models	• ACTL3001
• Subject 105	• Actuarial Mathematics 1	• ACTL3002
• Subject 106	• Actuarial Mathematics 2	• ACTL3003
• Subject 107	• Economics	• ECON1102 and ECON2101 or ECON1101 and ECON2102
• Subject 108	• Finance and Financial Reporting	• FINS2613 and ACCT2542
• Subject 109	• Financial Economics	• ACTL3004

*Equivalent subjects for students completing mathematics subjects.

Developing a New Actuarial Program
continued from page 7

education that is targeted at high-achieving school leaders who are selected on the basis of their character, motivation, and leadership potential, as well as their academic achievement. The program is a four-year degree including a major in actuarial studies and 15 months of industrial training with sponsoring organizations. Students follow an integrated sequence of academic studies and industrial training, which is jointly designed and overseen by university academics and employers. Students work with different industry sponsors for up to 15 months and receive a tax-free scholarship, which helps to serve as a living allowance during both the academic and industry phases of the program.

A significant number of employers outside the traditional life insurance and pensions area were looking for stronger statistical and quantitative skills in actuarial students than the existing commerce programs were providing. The actuarial studies subjects were designed to cover the statistical and mathematical foundations for these areas. However, it is recognized that there is a limit on what can be covered in a three-year undergraduate program. For this reason, programs of study that combine the Bachelor of Commerce with a Bachelor of Science or a higher degree program are being developed. These programs will combine statistics, mathematics, finance, insurance, and actuarial studies and will be developed in cooperation with the School of Banking and Finance and the School of Mathematics. These study programs will cater to students wishing to work in quantitative areas of finance and insurance. They will also provide a solid foundation for postgraduate study.

It was also important to provide study programs for students who have earned degrees in other areas, such as mathematics, science, and engineering, who wish to complete actuarial subjects. To cater to these students and to allow commerce students to complete further subjects at a Master's level, Master of Commerce subjects covering the Part I and Part II subjects of the Institute of Actuaries are planned to be offered in 2001.

Further information about the program can be found at http://149.171.208.125/actuarial.htm Comments or questions can be sent to me by e-mail at m.sherris@ unsw.edu.au.

Mike Sherris, ASA, is Professor in Actuarial Studies at the University of New South Wales, Sydney, Australia.

Minutes of the Education and Research Section Council Meeting

Wednesday, April 29, 1998
Chicago, Illinois

Leonard Asimov of Maryville University will be the new Editor of *Conversations*.

The IFAA asked the SOA to appoint a member to its Social Insurance Committee. The SOA recommended that an academic member fill this position. The Section Council discussed if expenses incurred to attend this meeting should be reimbursed under the academic initiatives program. The Council concluded that covering expenses related to international committee membership was not the intent of the academic initiatives and recommended that other sources of funding should be found to cover such expenses.

Howard Bolnick attended a portion of the Section Council meeting as a follow-up to the Symposium on Academic Relationships. A summary of the Symposium is available on the SOA web site. In addition, there is a task force being appointed to follow up on the symposium. The task force will be expected to issue a report near the end of the year or early next year. While the Section is not directly represented, we need to make our thoughts known.

The Council discussed the Research Paper option whereby actuarial students can receive exam credits for completion of a research paper. This option has not been popular. We will approach the Research Paper committee to encourage a review of the requirements and the process to determine whether this option could be more viable.

The Council decided to continue development of the Moderated List Server Group linked to the SOA web site. Participants must subscribe.

Volume 1998.1 of *ARCH*, which is the proceedings of the 32nd Actuarial Research Conference, has been mailed. The Council discussed the associated CD-ROM and elected to continue support of the CD-ROM for the next *ARCH*.

Respectfully Submitted,
Jeffrey A. Beckley, FSA
Secretary/Treasurer
Education and Research Section Council

Upper and Lower Bounds in the Estimation of Single-Decrement Rates

by Dale Borowiak

In multiple-decrement modeling a status may fail for a variety of reasons. Many life insurance and annuity calculations depend upon these models. For a history of multiple-decrement theory, refer to Seal (1977). In the traditional setting, the decrements are assumed to be independent (Elandt, Johnson, and Johnson 1980 and Cox and Oakes 1990). In more recent work, the dependent decrement model such as the common shock model (Marshall and Olkin 1967) and techniques employing the copula function, as described in Genst and McKay (1986), have been proposed. The impact of an assumed dependent structure among the sources of decrement on actuarial calculations has been investigated by Frees, Carriere, and Valdez (1996) and Gollier (1996).

The single or absolute decrement rates are the decrement rates when all the other decrements have been eliminated and, in general, are not identifiable. For a general reference, refer to Basu and Ghosh (1980) and Langberg, Proshan, and Quinzi (1978). Under certain distribution assumptions, single decrement rates have been derived (see Bowers, et al. 1986 and Jordan 1967).

In this paper, bounds on the single rates of decrement are given and illustrated with life table data. Further, the resulting effect of the uncertainty of the single-decrement rates on actuarial present value computations of insurance and annuities is explored.

Single-Decrement Rate Bounds

The notation used by Bowers et al. (1986) is utilized in the paper. Observed variables are the time of T and the cause of decrement denoted by J, for m causes of decrement $J=j$, $1 \le j \le m$. For a person age x, the decrement rates are

$${}_tq_x^{(j)} = P\left(x \le T < x+t,\ J=j \mid T \ge x\right) \quad \text{and}$$

${}_1q_x^{(j)} = q_x^{(j)}$ for $j=1, \ldots, m$. Also, $q_x^{(\tau)} = \Sigma\, q_x^{(j)}$ and $p_x^{(\tau)} = 1 - q_x^{(\tau)}$. The force of decrement due to $J=j$ is the joint probability density function of T and J divided by ${}_tp_x^{(\tau)}$ and is denoted $\mu_t^{(j)}$ and $\sum \mu_t^{(j)} = \mu_t^{(\tau)}$.

Elimination of all causes of decrement except $J=j$ leads to the single decrement rates, which we denote $q_x'^{(j)}$. Also, $p_x'^{(j)} = 1 - q_x'^{(j)}$. In this setting there are the natural bounds:

$$q_x^{(j)} \le q_x'^{(j)} \le q_x^{(\tau)} \tag{2.1}$$

In (2.1) the lower bound is strict while the upper bound can be improved. To derive an alternate upper bound, we use the well-known formula:

$$p_x'^{(j)} = \exp\left(-\int_0^1 \mu_{x+s}^{(j)}\, ds\right) \tag{2.2}$$

For decrement $J=j$ the probability density function is ${}_tp_x^{(\tau)}\ \mu_{x+t}^{(j)}$ so that $(d/dt){}_tq_x^{(j)} = {}_tp_x^{(\tau)}\ \mu_{x+t}^{(j)}$ and similarly $(d/dt)\ {}_tq_x^{(\tau)} = {}_tp_x^{(\tau)}\ \mu_{x+t}^{(\tau)}$. Hence,

$$\mu_{x+t}^{(j)} = -\frac{\left[\left(\frac{d}{dt}\right)\ln\left({}_tp_x^{(\tau)}\right)\right]\mu_{x+t}^{(j)}}{\mu_{x+t}^{(\tau)}}.$$

Using a Taylor Series expansion,

$$-\left(\frac{d}{dt}\right)\ln\left(1-{}_tq_x^{(\tau)}\right) = \sum_r \left({}_tq_x^{(\tau)}\right)^{r-1}\ {}_tp_x^{(\tau)}\ \mu_{x+t}^{(\tau)}.$$

Applying these, then (2.2) becomes:

$$p_x'^{(j)} = \exp\left(-\sum_{r=1}^{\infty}\int_0^1 \left[\left({}_tq_x^{(\tau)}\right)^{r-1}\ {}_tp_x^{(\tau)}\ \mu_{x+t}^{(j)}\right]dt\right) \tag{2.3}$$

As long as ${}_tq_x^{(\tau)} < 1$ at some point in [0,1], the integral in (2.3) is bounded above by $\left(q_x^{(\tau)}\right)^{r-1}\ q_x^{(j)}$ we find:

$$p_x'^{(j)} \ge \exp\left(-\frac{q_x^{(j)}}{1-q_x^{(\tau)}}\right)$$

and (2.4)

$$q_x'^{(j)} \le 1 - \exp\left(-\frac{q_x^{(j)}}{1-q_x^{(\tau)}}\right)$$

continued on page 10, column 1

Single-Decrement Rates
continued from page 9

For a full development of (2.4), see Borowiak (1997). We now give an example.

Example 1: An example given in Bowers et al. (1986, page 276) is used for demonstration. There are three causes of decrement, where the third cause is retirement that can occur between the ages of 65 and the mandatory age of 70. The decrement rates, $q_x^{(j)}$, are assumed known and the upper bound (2.4) is computed. These values are listed in Table 1.

From Table 1, observe that the range in the single decrement rates, given by the left-hand side of (2.1) and the right-hand side of (2.4), is fairly small in absolute value.

TABLE 1
Single Decrement Rate Bounds

	Multiple Decrement Rates			Upper Bounds		
Age *x*	*J*=1	*J*=2	*J*=3	*J*=1	*J*=2	*J*=3
65	0.0194	0.0194	0.0392	0.0282	0.0282	0.0416
66	0.0240	0.0192	0.0587	0.0264	0.0211	0.0632
67	0.0285	0.0189	0.0780	0.0321	0.0214	0.0854
68	0.0329	0.0187	0.0973	0.0379	0.0217	0.1080
69	0.0372	0.0184	0.1165	0.0439	0.0220	0.1313
70	1.0000	—	—	—	—	—

TABLE 2
Actuarial Present Value Bounds

Lower Bounds			Upper Bounds		
J=1	*J*=2	*J*=3	*J*=1	*J*=2	*J*=3
0.71792	0.07661	0.27465	0.71834	0.09248	0.29770

Actuarial Present Value Calculations

This section explores the effect of the uncertainty in the single-decrement rates on simple insurance and annuity calculations. To do this, note that insurance and annuity present values are monotone functions of changes in the individual decrement probabilities. The actuarial present value for insurance is an increasing function in each decrement probability. Hence, upper and lower bounds on the actuarial present value for insurance are found by utilizing the upper bound in (2.4) and the multiple-decrement rates, respectively, for the year-by-year decrement rates in calculations. Similarly, for annuities the actuarial present value is a decreasing function in decrement probabilities. The upper and lower bounds on the actuarial present value calculations use, respectively, the multiple decrement rates and the upper bound in (2.4).

Example 2: Let the setting described in Example 1 hold. For exposition, whole-life insurance policies are taken out based on the single-decrement probabilities where a unit benefit is paid at the end of the year. Upper and lower bounds on the actuarial present value of these policies are computed and are listed in Table 2.

In Table 2, we find a difference can be as much as 0.01587 (for $J=2$), which is 20.7% of the lower bound. The effect of the uncertain nature of the single-decrement rates must be included in these actuarial calculations.

Conclusion

In estimating single-decrement rates with no distribution assumptions, only lower and upper bounds can be computed. These bounds appear to be fairly narrow considering their robust nature. However, in actuarial calculations, such as actuarial present values, the ranges of these rates must be considered.

Dale Borowiak is with the Department of Mathematical Sciences at the University of Akron in Akron, Ohio.

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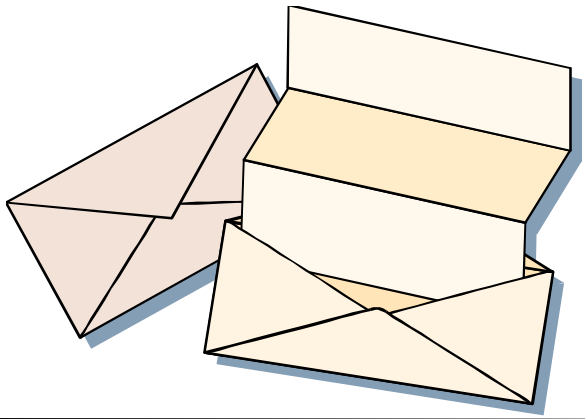

Education and Research Sessions at the Annual Meeting

October 18–21, 1998
New York, New York

The 1998 SOA Annual Meeting will be held at the New York Marquis Marriott Sunday, October 18 through Wednesday, October 21, 1998.

The Education and Research Section is sponsoring a continental breakfast council meeting on Tuesday, October 20, 1998, from 8:00 a.m. until 10:00 a.m. All members of the Section are invited to attend.

In addition, the Section is sponsoring the following technical sessions.

Monday, October 19

10:30 A.M.–12:00 NOON

14TS CREDIBILITY AND HEALTH INSURANCE

Instructors: Thomas N. Herzog
H. Dennis Tolley

Instructors present a tutorial on elementary concepts in credibility theory and their application to health insurance. The instructors discuss the concept of full credibility and describe the conditions that need to be met for experience data to be fully credible.

Tuesday, October 20

8:00–10:00 A.M.

52SM EDUCATION AND RESEARCH SECTION COUNCIL CONTINENTAL BREAKFAST MEETING

Chairperson: Curtis Huntington

This session (with continental breakfast) provides an opportunity for the Education and Research Section Council to conduct a business meeting. The first portion of the meeting is devoted to usual section business matters. The session also provides attendees with a forum for discussing items of interest.

10:30 A.M.–12:00 NOON

78TS APPLYING SIMULATION TECHNIQUES TO VALUATION PROBLEMS

Instructors: William J. Morokoff
Hal Warren Pedersen

The instructors review Monte Carlo and quasi-Monte Carlo simulation techniques and show how to apply such techniques to some important classes of valuation problems. For example, the instructors demonstrate how to use simulation techniques to implement term structure models. The instructors identify difficulties likely to be encountered in practical applications and show how to surmount such potential stumbling blocks. Important computational techniques, such as variance reduction, are illustrated in the context of specific financial products.

Session participants explore the application of select simulation techniques in solving practical valuation problems.

2:30–4:00 P.M.

93PD ONCE IN A HUNDRED YEARS

Moderator: Irwin T. Vanderhoof
Panel: Allan Brender
Willis B. Howard, Jr.
George Pennachie
Irwin T. Vanderhoof
Robert E. Wilcox

The recent problems with the Asian banking systems as well as the problems with S&Ls in the U.S. during the 1980s demonstrate that a capitalistic economic system cannot function without healthy banks and insurance companies. Not only must the banks and insurance companies be profitable and solvent, but they must be perceived by the public as being absolutely safe for deposits of their funds.

The panelists discuss the following three levels of protection available to bank depositors and insurance purchases in the U.S.: (1) risk-based capital of the individual financial institution, (2) existence of the FDIC and the other federal guarantee corporations, and (3) eagerness with which general federal funds can be used to bail out S&Ls or Asian banks. While the various mechanisms are already in existence, it is not clear that there is any rational basis for their relationships.

Session participants learn about potential solvency problems of major financial systems throughout the world.

Wednesday, October 21

8:00–9:30 A.M.

123TS APPLYING STATISTICAL MODELS TO PRACTICAL ACTUARIAL PROBLEMS

Instructors: Arnold F. Shapiro
Virginia Ruth Young

Professor Shapiro describes a number of the actuarial and financial modeling techniques discussed at the recent SOA conference on modeling. These techniques include SPR, fractal analysis, and fusion algorithms. He discusses how each technique can be used to solve practical actuarial problems.

Professor Young develops links between credibility theory in actuarial science and longitudinal data models in statistics. In particular, she shows that credibility models are special cases of longitudinal data models. This enables the actuary to use widely available statistical software packages to easily construct credibility models. Case studies will illustrate the practical application of these techniques.

Participants in this teaching session examine the practical implications of select modeling techniques in actuarial work.

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