Actuarial Statistics - The European Perspective

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1. Some preparatory remarks

In a discussion between university teachers on the topic "Actuarial Statistics in the University Curriculum", a reasonable procedure would seem to be the following. Delimit the area of actuarial statistics, pin down its subject matter and scientific contents, designate on this basis a study programme in the field, and discuss finally how it could be efficiently organised in a university environment. Unfortunately, this simple outline would be too narrow to accommodate certain major issues of the discussions conducted on the topic in a broader forum and, in particular, in actuarial circuits. Thus, a wider scope must be taken.

Those times are at an end when the universities were sanctuaries for academics philosophising on otherworldly puzzles. In today's society innovative capacity and specialised knowledge are crucial forms of productively employed capital and, being manufacturers of basic research and higher education, the universities have become a key industry. From trade organisations, professional bodies, and the public in general, there is a heavy demand for a variety of university services, some of which may be on the side of the primary academic operations. I find it necessary to identify the interests expressing demands for actuarial competence, and to contemplate which actions, if any, should be taken by the university to supply the requested services. This will be the issue of Sections 2 and 3 of this paper. In Section 4 the Danish solution is treated in some detail since in many respects it is typical and, therefore, serves well as background for discussions. In Section 5, other European solutions are briefly surveyed. In Section 6 some general aspects of the feasible solutions are discussed, and in Section 7 a plan for the complete training of actuaries is sketched.

Any treatment of the topic of this session must be a blend of factual information and personal views. I am confident that the audience will be able to separate facts from judgements in my presentation.

2. Demands for actuarial statistics in Society

In virtually all fields of human activity there is some undesirable element of risk involved. Those forms of risk that can be quantified in economic terms may be eliminated or mitigated through insurance or other forms of risk exchange. Thus, one might say that the need for actuarial work is quite universal. The ways these needs are registered and expressed as demands depend, however, on legislative, social, and economic structures - the market conditions, to put it simply.

The major purchasers of actuarial know-how are the insurance companies. Their demand for actuarial skills has varied over the ages and also between different lines of insurance. Their demand for actuaries, which is something else, has been more permanent, however - partly because life and pension insurers are usually required by statute to employ an insurance mathematician. At times some branches of the insurance industry were organised in cartel-like bodies, and at times there was more competition. Irrespective of its organisational pattern, the insurance industry never invested heavily in actuarial studies, in striking contrast to other know-how-based industries which, by necessity, developed infrastructures of applied research. I can only briefly indicate my diagnosis of this state of affairs. First, to assess the value of an insurance product, one must have access to statistics and statistical competence. Buyers of insurance products dispose of neither of these resources and, being risk averse, they are generally willing to pay premiums far in excess of the full cost rate. Second, by tradition the supervisory authorities do not maintain price control functions; their primary concern is solvency rather than equity, and they will typically require that premiums and reserves be well on the safe side. Now, to set a premium that can be tolerated at the market does not take too much advanced study, and it might even be that careful actuarial calculations would appear as a nuisance to an insurer in a situation where large profits are accepted.

Which brings us to the actuaries themselves. The vast majority work in insurance companies, and their views of the significance of actuarial statistics are inevitably guided by those of their employers. For reasons already touched on, the insurance industry has not had a strong incentive to employ high and diversified competence. The actuaries have managed to create and defend a hegemonic position as The Academics of Insurance, maintaining a variety of functions apart from the specifically actuarial ones, in management, sales, ADP, investment, etc., and with management leadership rather than actuarial craftsmanship as the summit of the career pyramid. This circumstance is reflected in certain characteristic features of the actuarial professional bodies - the national actuarial societies and their international super-structures. They are remarkably closed, the main criterion for election of members being the formal educational or occupational background. It follows inevitably that a number of experts in risk analysis and related fields are effectively excluded from these organisations. In short, the primary concern of the actuarial professional bodies is that of any trade union: the protection and promotion of the professionals rather than their profession. It is only logical that actuaries favour an actuarial education that serves their career goals, and at present call for a rather broad vocational training adapted to current actuarial, financial, and managerial functions in insurance offices.

Finally, I will mention the interests of the public as represented by the legislative bodies and supervisory authorities, whose role has been indicated already. They set the legal framework of insurance activities, but in educational matters they play

a reticent role. Typically, the supervisory authorities recognise chief actuaries, and thereby they lay down the professional requirements for an actuary, at least formally.

3. Actuarial statistics as a university discipline

The primary responsibility of the universities is the maintenance and extension of specialised knowledge, and in particular the organisation of basic research and higher education. Thus, there is one sufficient - and I would also say necessary - reason why actuarial statistics should have a place in the university curriculum: it is a viable branch of science. The subject matter of actuarial statistics is the various kinds of risk dealt with in insurance and social security systems - how they can be defined in quantitative terms, assessed statistically, and controlled by insurance arrangements. The precise treatment of these problems always rested heavily on the mathematical theories of probability and statistical inference, and conversely, insurance matters have played an important role as a source of inspiration and development of these mathematical disciplines. The early attempts to construct tables of life contingencies in the 17th and 18th centuries enforced a clarification of the very concept of probability. At the beginning of this century Lundberg launched a collective risk theory which on heuristic grounds established sophisticated results on generalised Poisson processes, some thirty years before precise contents were given to the notion of stochastic processes. Modern life history analysis, which is an indispensible tool in biomedical statistics, reliability theory, and demography, owes much of its development to life insurance mathematicians. In recent years insurance problems have called for and brought about new developments in empirical Bayes theory.

In conclusion, actuarial statistics is a field of scientific inquiry, and as such it has its natural place in the university curriculum on a par with other academic disciplines. This implies that research and teaching in the field should be organised in a university institution with full-time scientific positions and budgetary frames that can accommodate long-term projects.

4. The Scandinavian concept

If I were to pick the title of this talk, I would have coined it differently. In fact, the European perspective is global as it takes in all major types of systems for education of actuaries. The major dividing line is to be placed between what can suitably be called the Scandinavian concept, whereby actuarial education is placed in the university and the title of actuary is by statute an academic degree, and the Anglo-American one, whereby the actuarial societies organise the training of actuaries.

The Scandinavian concept has been presented elsewhere, notably in Hoem and Mortensen (1980), Harbitz et al. (1980) and Sverdrup (1954), which have greatly influenced the material presented here. I shall set out by describing in some detail actuarial education in Denmark. The University of Copenhagen offers the only actuarial study programme in the country; it leads to a master's degree in actuarial science, the cand. act. degree. The instruction is run by the Laboratory of Actuarial Mathematics, a department of the Central Institute of Mathematics. It has one professor and two

lecturers of actuarial mathematics working full-time in teaching and research.

The actuarial study programme is scheduled to normally require five years of full-time study. Approximately the first 3.5 units (one unit is one year's workload) are devoted to compulsory courses in mathematical subjects: computer science (1/3 units), mathematics (linear algebra, analysis, and measure theory; 2/3 units), statistics (probability based on measure theory, stochastic processes, and principles of statistical inference; 1+1/12 units), background topics in insurance (insurance systems, accountancy, and insurance law; 1/6 units), insurance mathematics (life insurance mathematics based on the theory of stochastic processes, non-life insurance mathematics, general risk theory, and a project of applied orientation; 1+1/6 units).

The compulsory core is supplemented by elective courses with a total workload of 1+1/12 units. Out of this at least 1/2 unit should be made up by courses in mathematical subjects. For the remaining 7/12 units there is much latitude in the choice of courses which, apart from mathematical subjects, may be within economics, law, or any other subject area of relevance to actuarial work.

The final 1/2 unit is spent on writing a master's thesis on a topic in actuarial mathematics, broadly defined. The topic may be purely theoretical or largely empirical, but in any case it should involve elements of theoretical investigation.

In the remainder of this section I shall point out some major features and consequences of the concept described here.

Actuarial instruction is given in a normal university atmosphere, dominated by the standards set by a strong mathematics and statistics environment. The students are made firmly acquainted with these basic disciplines and the methodology of insurance mathematics, and are brought in touch with scientific inquiry through their thesis work. I use the word "methodology" instead of "methods" to stress that the programme does not aim at training the students to run established routines of actuarial offices, but rather educating them in the principles of actuarial thinking. The purpose is to enable the actuarial candidates to formulate appropriate models for currently emerging actuarial issues and to solve the mathematical problems arising from them.

The compulsory courses in insurance mathematics centre on the classical subject matter related to the studies of liability risks. Courses in the mathematics of finance treating assets risk can be included in the elective part of the coursework.

The term "actuary" is linked to the academic degree cand. act. This means that, although the title of actuary is not protected by law, it is not entirely left to employers and professional bodies to define the level and orientation of the competence required to hold this title. The supervisory office applies the criteria set by the university degree in their authorisation of chief actuaries. Thus, the standards are set by an independent professional institution and not by those parties that are subject to supervision.

5. The European perspective

The Norwegian solution is very close to the Danish one, hence the term "Scandinavian concept". Its antithesis is the British (and USA) solution, as explained in the introduction. In Britain there is no academic actuarial degree. Actuarial courses are taught at university institutes of statistics and actuarial science, but their contents are to some extent designed so as to qualify for exemption from examinations in the study

programme conducted by the actuarial society.

In the central-European countries a variety of solutions are found, and I shall be content to point out just some main features. In some countries there are universities offering actuarial study programmes leading to an actuarial degree (e.g. France, The Netherlands, Belgium). The study programmes vary in content as well as duration, e.g. in France three years at undergraduate level and, on the other extreme, in Belgium two years of further studies on top of a master's degree (four years) in mathematics, engineering, or economics. In most countries the title of actuary is held by elected members of the national actuarial society. University courses in actuarial topics are offered within the framework of studies in applied mathematics or econometrics, in some cases (e.g. Finland) as upgrading courses in cooperation with the insurance companies and the actuarial societies. In some universities teachers in actuarial mathematics have only part-time positions (Sweden and The Netherlands).

A survey of actuarial study programmes in different countries, not quite up to date but still useful, is found in *The Training of the Actuary* (1980).

6. Possible alternatives to the Scandinavian concept

The instruction in insurance mathematics in the Danish programme focusses on liability risks. It is often asserted nowadays that the risk associated with the assets is equally, if not more, important to insurers. Recently a special section of the International Actuarial Association was founded and entitled Actuarial Approach for Financial Risks. In a sense the problems associated with asset risks are harder than those associated with liability risks: asset risks are rooted in political, social, and economic phenomena of great complexity, whereas the fluctuations of insurance liabilities are governed to a greater extent by mechanisms that lend themselves to the well-established methodology of the "exact sciences". This does not mean that the analysis of the liabilities is of secondary importance. Just look at the classical life insurance mathematics. For decades it has been praised by actuaries as a largely perfect structure. However, it was not the mathematics that was perfect, but rather the idyll of the insurers in a situation where uniform premiums with substantial safety loadings created great surplus. Life insurers are now forced to compete, and suddenly the imperfection of the classical techniques are brought to light in confused discussions of how to determine appropriate premiums in different risk classes and how to redistribute surplus, in short, how to measure the risk. Studies in liability risks call for the best of human intellect, and I strongly disapprove of including a substantial study of financial risks at the price of studies of liability risks.

I understand that the actuaries would like to fill the vacuum that has been opened with the recognition of the many new and unsolved asset risks problems, and they would certainly conduct good trade unionism in presenting themselves as the magicians of insurance finances. Such interests are, however, no concern of the universities. Partly in response to the widespread need for analysis of financial risks, Danish universities have lately organised a study programme in mathematical economics, which is a synthesis of social sciences and mathematics at advanced level. The philosophy underlying this solution is the same as the one I formulated for the actuarial study programme above. It implies, inter alia, that actuaries are not in the position of

becoming experts of finance just because they master some mathematics.

There is room for discussion of how to design the profile of an actuarial study programme, and it might well be that emphasis should be placed on financial risks in, say, a special variant of actuarial studies under the programme. However, whichever orientation of the study programme one chooses, it must have sufficient depth to produce candidates that can offer expert advice in their field and form a basis for recruitment to basic research.

In actuarial circuits it is a widespread opinion that at the end of the studies the actuarial candidate should have a broad knowledge, some accountancy, some law, some finance, some economics (macro and micro), some business management, and - consequently - some insurance mathematics: jack of all trades, master of none. Note that the study programme described above comprises a course in general insurance topics, accountancy, and law. It is included since it is judged necessary as a background for the main subjects in the programme.

7. A complete programme for the formation of an actuary

Let me stress that I do not claim that actuaries can do without supplementary knowledge in neighbouring subject areas and knowledge of the run-of-the-mill operations in an insurance company. What I advocate is that one should emotionlessly determine which parts of the training of the actuary should be placed at the university and which parts belong elsewhere. It is not a responsibility of the university to prepare the actuarial students for the handling of every specific problem that they may be exposed to in their many possible pursuits of life. This responsibility remains with the insurance industry and the actuarial professional bodies. They should, according to a normal procedure, raise the necessary funds to organise a system of further training and upgrading courses in disciplines that are outside of the actuarial speciality, but still a necessary part of the experience required from employees in the insurance business. Postgraduate courses at the university would, of course, always serve as an offer of further education to actuarial candidates after they have obtained their university degree.

References

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