OBITUARY

GUNNAR BENKTANDER 1919–2018

BY

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Gunnar Benktander passed away on February 25, 2018 at the age of 99. He left his family, and also the actuarial (non-life) community, after a long and very full life.

When Gunnar started to study Mathematics in Uppsala (Sweden), he had already decided to become an actuary. As a conscript in World War II, he ended up working in code breaking. In 1944, he was employed by the Association of Farmers' Mutual Fire Insurance Companies. He worked on the analysis of tariffs and reinsurance within the Association. Soon, Gunnar became known as an active participant in the international actuarial community, and he made a significant contribution to the creation of a non-life section of the International Actuarial Association. Thus, he is one of the fathers of ASTIN, which was founded in 1957, see Benktander (1997). In 1959, Gunnar moved to the reinsurance company Swedish Atlas. In 1960, Gunnar submitted (together with C.O. Segerdahl) a paper to the International Congress of Actuaries on suitable distributions for use in reinsurance pricing, see Benktander and Segerdahl (1960). The distributional behaviour of the few very large claims was completely unexplored at that time. Thus, this paper was an important first step to creating a scientific basis for reinsurance pricing.

In 1965, Swiss Re hired Gunnar to improve their reinsurance pricing and reserving procedures. An important task was the proper handling of monetary and social inflation, which affects claims severity as well as claims frequency above a deductible in a complicated way. Gunnar did this very successfully and, after a while, he was promoted to Chief Actuary Non-Life of Swiss Re. He took part in almost all ASTIN colloquia until 2009, i.e. over more than fifty years, and he made many important contributions, by speeches as well as by written papers. After his retirement in 1979, Gunnar still did some consulting and kept in close touch with the actuarial field. In 1974, he had gathered a circle of renowned actuaries from various countries to form the so-called RESTIN group, where at yearly meetings, problems and solutions relating to (re)insurance practice were discussed. Gunnar participated in these meetings until 2008. This means that even in 2008 at the age of 89, he followed the actuarial discussions and made oral contributions. This is a fantastic achievement!

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To understand the importance and value of Gunnar's contributions to the actuarial profession, we must recall that in the 1950s and 1960s, non-life actuarial work was still in its infancy, and personal computers were not available. Especially for reinsurance, calculations based on claims distributions are very complicated, and more often than not, simple formulae just could not be developed. Therefore, most of the practical work was done on a burning cost basis, i.e. on the basis of the real loss figures of the last few years of the individual client. This means that the reinsurance actuary had to arrive at a price using experience of perhaps only some 5 to 15 actual past claims. Gunnar had an excellent mathematical background and a fantastic actuarial feeling on how the parameters of a reinsurance treaty should influence the price. Thus, he was able to develop approximate procedures and useful practical rules of thumb. Moreover, he did not keep these for himself but published them not only in scientific journals but also in general insurance magazines. There, he presented his proposed procedures together with numerical examples in an easily understandable way and was thus able to reach underwriters, management and other non-actuarial groups in the reinsurance industry. Thus, Gunnar soon became the master of reinsurance pricing worldwide. To give the reader an idea of his achievements, a few examples are as follows.

One of Gunnar's most cited papers is his (and C.O. Segerdahl's) above mentioned work from 1960, see Benktander and Segerdahl (1960). Here, he introduced and investigated the concept of the average excess claim defined as

$$m(x) = E(Y - x | Y > x).$$

Today, the concept the average excess claim is known as the mean excess loss and is an important concept in modern extreme value theory (EVT).

Gunnar found out that empirical loss distributions often showed an increasing average excess claim $m(x)$. He checked this with several analytical claims distributions and showed that the $m(x)$ of the Pareto distribution is an increasing straight line and the average excess claim of the exponential distribution is a horizontal line and he classified *dangerous distributions* as distributions having an average excess claim between the $m(x)$ for the exponential distribution and the $m(x)$ for the Pareto distribution — like the definition of *sub-exponential distributions* in modern EVT.

As he found out that the empirical average excess claim very often was slightly concave, he defined two new loss distributions known as Benktander type I and Benktander type II using the average excess claim, both well known today (see e.g. Thomas Mikosch: Non-Life Insurance Mathematics, Springer 2004, p. 104). Gunnar also introduced other concepts which are used today in EVT, e.g. the rate of mortality (known as hazard rate in EVT). He defined *the Pareto class in a wide sense* which is the same as regularly varying distributions in modern EVT. See e.g. Benktander (1962) and Benktander (1970b).

During his many years in Swiss Re, Gunnar performed a considerable amount of work on methods used for pricing excess of loss business and

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produced some ground-breaking results. Back in the 1960's and 1970's, exact calculations often were very time-consuming and thus not possible in daily work. Therefore, he developed several rules of thumb as quite good approximations of the exact methods. These rules of thumb made it possible to use more sophisticated premium calculation methods in daily work. In this way, Gunnar was one of the pioneers introducing the use of parametric distributions as opposed to the burning cost methods which were used by the underwriters at that time.

The fluctuation loading was often calculated proportional to the standard deviation of the total claims to the excess layer, and as an approximation of the standard deviation, he showed that for all claims size distributions and Poisson distributed number of claims,

$$\sigma \leq \sqrt{E \cdot L}$$

where E is the expected loss to the layer, σ is the standard deviation and L is the liability of the layer. In motor reinsurance, the top layer is very often unlimited, and therefore he suggested the approximation formula

$$\frac{\sigma}{E} = \frac{1}{\sqrt{n}} \cdot \frac{2}{1 + {}^{1}/_{k}}$$

be used for motor excess of loss business. Here, n is the expected number of claims to the layer and k is the relative length of the layer, i.e. $k = (x + L)/x$ for a layer L xs x. The formula is valid also for an unlimited layer having $1/k = 0$ and is exact in the Poisson-Pareto case with Pareto parameter $\alpha = 3$. See e.g. Benktander (1969), Benktander (1975b) and Benktander (1988).

One of the issues in rating excess of loss business is the designing of variable premium rates where the premium rate equals the burning cost of the period subject to a minimum m and a maximum M. Here too, Gunnar presented some rules of thumb. The most elegant of these, *the accordion rule*, is described in Benktander (1991). The idea is to require break even, i.e. that the expected net variable rate equals the expected burning cost E without limits. Gunnar showed that requiring

$$m \cdot M = E^2$$

would lead to results close to such a break even. This means that the reinsurance underwriter may easily transform a flat rate into a variable rate without any additional calculation if he keeps $m \cdot M = E^2$. Gunnar called this "incomplete nonsense treaty", completeness being reached if $m = 0$ and $M = \infty$ where the reinsured company pays all the claims itself.

A very important issue in non-proportional reinsurance is inflation, which has a much more significant impact on an excess-of-loss layer than on the underlying retention. This is exacerbated in liability reinsurance owing to the long development of the claims with personal injury. Therefore, the so-called index clause is used to share the effect of inflation more equally between the ceding

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company and the reinsurer by indexing the excess point according to the wage inflation in a rather complicated way. With no index clause, the full effect of inflation and the long development is carried by the reinsurer alone. Since an exact calculation of the premium for a cover with an index clause is very complicated, taking into consideration all the individual loss histories including the development of each claim, Gunnar suggested to calculate the premium for a cover without an index clause and then reduce the premium. The size of this reduction will depend on the average delay of settlement t, on the wage increase i and on the claims size distribution. Gunnar developed the following rule of thumb for the relation r between the stabilized (i.e. with index clause) and unstabilized burning cost, expressed as $r = 1/(1+d)$ where $d = t \cdot i \cdot x/m(x)$. See Benktander (1969).

Moreover, Gunnar found out that in many European countries the average claim size in motor insurance tended to increase more or less in conjunction with wages, but that the high claims embracing bodily injury showed a much higher rate of increase. Gunnar came to the evidence that this was caused by changes in court practice, loss settlement practice and the fact that medical costs had a distinctly higher inflation than wages, now known as social inflation. He called this phenomenon "superimposed inflation", and he showed that every percentage point of superimposed inflation roughly leads to a 10% increase in the necessary excess premium rate, see Benktander (1968). These findings led to a fundamental change in motor excess pricing.

In 1976, Gunnar suggested a claims-reserving method which is very intuitive and simple to use, see Benktander (1976a). He proposed a credibility mixture of the Bornhuetter–Ferguson (BF) and the Chain-Ladder (CL) methods. The BF method is based on an initial estimate U_{BF} of the ultimate cost, usually derived from the premium via an expected loss ratio. On the other hand, the CL method uses the actual known loss amount A and develops it to ultimate using a so-called lag-factor p, i.e. $U_{CL} = A/p$. Gunnar proposed to use a credibility mixture

$$U_{GB} = c \cdot U_{CL} + (1-c) \cdot U_{BF}$$

which gives an analogous formula for the reserves, too. For the credibility factor c, he recommends using $c = p$ because they must have a similar behaviour over the development.

He published this in The Actuarial Review, the quarterly newsletter of the U.S. Casualty Actuarial Society, which was not well known in Europe. Therefore, his method was independently reinvented later by other actuaries in Europe, too. Moreover, it has been shown that the Benktander mixture outperforms the BF and CL methods in many situations. This may serve as an example of the high quality of Gunnar's approximation formulas.

The many topics on which Gunnar wrote and the many journals to which he contributed, can best be seen from the following list of references, which is hoped to be almost complete (except many unpublished or internal notes).

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In summary, Gunnar was greatly respected by those in both the practical and theoretical fields of non-life insurance, to an extent that is perhaps unique.

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