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AN AMERICAN ACTUARY LOOKS AT RISK MANAGEMENT

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This paper presents an overview, a book review, and a challenge to you, the reader.

1. An overview of the role of the American actuary in risk management today.

2. A book review of a remarkable new work by a philosopher of science which provides a framework we actuaries can use to develop better actuarial methods for risk managers and others.

3. A challenge--actually, two of them--to the reader to 1) criticize the suggestions made in the second section about how to develop better methods, and 2) follow the guidelines as revised to develop better actuarial methods for risk managers.

I. AMERICAN ACTUARIES IN RISK MANAGEMENT

American actuaries are increasingly involved in risk management. Although a few actuaries are risk managers for major corporations, most actuarial services are provided by consulting actuaries. Also, in the U.S. "risk management" usually refers to the handling of property and casualty risks, so most consulting actuaries active in risk management are casualty actuaries.

Actuaries' skills are most often used for the following types of problems:

- Projecting loss costs.
- Evaluating liabilities for outstanding casualty losses.
- Evaluating alternative financing arrangements for property and casualty risks.
- Recommending particular funding levels and risk financing plans.

The actuary's client is usually a public agency or private corporation. His contact is usually the risk manager. Although job descriptions vary, the risk manager is typically a middle manager with some background in insurance or, less often, finance. His or her responsibilities usually include the organization of the risk financing program, the placement of insurance, and the recordkeeping associated with insurance and self-insurance programs. The risk manager typically reports to the chief financial officer, but there are many exceptions.

Many actuarial concepts have obvious applications to risk management. A partial list is as follows:

- Credibility
- Distributions of loss by size
- Collective risk (distribution of aggregate losses)
- Interest theory

There are about 3,000 risk managers in the U.S. There are about 100 casualty actuaries actively involved in risk management. This 30-to-1 ratio has existed for some time. As a result of the small number of actuaries, most risk managers project losses, estimate loss ratios on excess insurance policies, and allocate costs among cost centers without the benefit of advice from actuaries. Indeed, all of the members of the Casualty Actuarial Society together do not have the time or resources to perform all of the actuarial work in risk management.

Most risk managers have never used the services of an actuary. Most have used the services of a public accounting firm, often many times. Because of the overlap between the actuary's services and the accountant's, accountants sometimes provide estimates of outstanding losses, allocations of loss costs, or other figures of an actuarial nature.

The Actuary's Most Constructive Role

The actuary's most constructive role in risk management is to provide risk managers and accountants the basics of actuarial science. As much as we might wish to play an integral role in the day-to-day actuarial element of risk management, the work to be done is too extensive for the small number of actuaries to undertake, and it is also too routine to command the credentials of membership in the Casualty Actuarial Society.[1]

Many risk managers are interested in learning the basics. Examples of this interest are:

- Sessions on using computers in risk management have been well attended at recent meetings of the Risk and Insurance Management Society (RIMS).
- This author gave a talk on risk analysis at a recent RIMS meeting which was extremely well received.
- Professor John Cozzolino of the Wharton School has held a number of seminars teaching risk managers several aspects of risk analysis.
- One of this author's current assignments includes, at the risk manager's suggestion, providing methods to calculate outstanding losses at future dates.

The major public accounting firms in the U.S. have split along two schools of thought. One group of firms does not perform actuarial services. Firms in the other group actively solicit actuarial work and employ members of the C.A.S., typically in their management consulting divisions. Smaller accounting firms, perhaps less concerned about the niceties of the big firms' philosophies, are providing loss projections and cost allocations with increasing frequency.

Although actuaries cannot and should not seek to be consulted about all actuarial matters, actuaries are uniquely positioned and qualified to improve risk managers' and accountants' actuarial skills. First, we have the respect of the leadership of the risk management profession. Second, we have enough depth of understanding of the actuarial issues so we can develop the methods the risk managers ought to use. Third, we have the motivation; we will command the

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1 Membership in the C.A.S. requires successful completion of seven examinations on subjects ranging from advanced statistics to the details of insurance accounting. Only a fraction of the examination material is important for day-to-day risk management.

highest possible price in the marketplace if we provide the highest and best use of our skills.

Our role is like that of the scientist in medicine. The scientist in medicine develops the principles on which medical practice advances. Although most physicians and surgeons are not scientists, all physicians and surgeons owe the success of their profession to scientists. These scientists may be practicing physicians, teachers, or researchers, just as actuaries may be risk managers, teachers, or researchers. The difference between the scientist and the practitioner is not one of skill or experience; it is a difference in goal: the scientist is concerned with developing and testing problem-solving strategies, while the practioner is concerned only with applying them.

II. OUR BEST, MOST TEACHABLE SCIENCE

If, as we have argued, our long-term challenge is to provide risk managers and accountants the basics of actuarial science, then our first task is to identify the basics of actuarial science that apply to risk management. The basics we choose to teach--the guidelines for lay practice, if you will--must also be reasonably teachable.

The basic science we provide must be timeless and it must be practical. Risk managers should be able to take hold of our methods and apply them without major change for a period of many years. Moreover, change, where it does come, should come because the risk managers learn to do still more, not because the methods were poor, just as the theory of relativity is used instead of Newtonian mechanics when its refinements are important, and not because Newtonian mechanics was wrong all along. If risk managers develop actuarial skills that help them throughout their careers, they will have more respect for actuarial science and for actuaries as well.

It is not important for the risk manager to learn the theoretical underpinnings of actuarial science, any more than it is important for the construction engineer to learn quantum mechanics. It is only important for him or her to know practical methods. Actuaries have the professional responsibility to make sure the methods taught to risk managers have the appropriate theoretical foundation. Having done so, we should not limit the actuarial methods we advance to those that have a simple theoretical basis. We should advance the best methods that are still easy enough to apply to win acceptance.

Good Science

At first glance, it seems difficult to tell what parts of actuarial science are the best science. Fortunately, a thorough study of what makes a scientific theory valuable suggests we can identify our best science. In an important new book, Kitcher (1982) sets forth for the layman the findings of philosophers of science about what makes good science.

Kitcher explains that good science has three attributes:

1. "A science should be unified. . . . Good theories consist of just one problem-solving strategy, or a small family of problem-solving strategies, that can be applied to a wide range of problems." (p. 47)

2. Application of the basic problem-solving strategies requires additional hypotheses, at least about the process by which results are observed, but "an auxiliary hypothesis ought to be testable independently of the particular problem it is introduced to solve, independently of the theory it is designed to save." (p. 46)

3. "A great scientific theory opens up new areas of research. . . . Fecundity grows out of incompleteness when a theory opens up new and profitable lines of investigation." (pp. 47-48)

These guidelines sound like no more than common sense, but they are not common knowledge or common practice. That is, they aren't widely known or widely used. With a few exceptions, actuaries' methods in risk management appear to be a patchwork of special methods to solve particular problems. We shouldn't be surprised to find that risk managers find our methods odd. We will have more credibility when we give risk managers a small number of problem-solving strategies that solve a large number of problems and that lead risk managers to a greater understanding of their problems.

Teachable Science

My limited experience suggests that for a scientific method to be readily learned, it must have two qualities:

1. The method should be directly applicable to some set of problems. Approaches that require the risk manager to develop his or her own auxiliary assumptions, or to perform mathematical analyses (in addition to computations), will not be used and will soon be forgotten.

2. The method should not require an unreasonable amount of calculations. Methods to solve small problems should involve small amounts of computation. Methods to solve big problems may require lengthy calculations, but if so, the methods should show the meaning of various figures derived in the course of the calculations. Nothing more discourages an effort to calculate a value than hours of work with no apparent result.

A lack of directness undid my efforts to answer a letter by Charles V. Schaller-Kelly (The Actuary, May, 1983). Schaller-Kelly's problem was to develop modifications of a formula for the mortality of a group of lives to reflect the experience of a much smaller, slightly related group of lives. I was unable to apply a Bayesian or empirical Bayesian approach because those approaches required mathematical derivations that a) took time to develop and b) would not have been reliable without review by another appropriately trained actuary.

Our methods are often inappropriately tedious. We must develop methods that are susceptible to reasonable calculation, even though we must sacrifice precision, reliability, or unbiasedness to do so.

Current Actuarial Science

Kitcher's arguments are so persuasive that his three points will probably hold up under further scrutiny. The two points about teachability are tentative and may be revised substantially as time goes on. Still, it is interesting to apply these five tests to several actuarial methods and see how our methods rate.

Exhibit 1 shows this author's answers for the five points for ten different actuarial methods. The ratings for the first method, abbreviated "the actuarial equation," illustrates the application of the five points:

1. Unified?

   Yes. The actuarial equation, which states the present value of the expected value of a set of costs, provides a simple set of problem-solving strategies that can be applied to a wide variety of risk-management problems.

2. Assumptions testable?

   Yes. Assumptions about probabilities, interest rates, and amounts of loss costs can be checked independently of the actuarial equation.

3. Fecund?

   Yes. Shortcomings in the method suggest important areas of interest. For example, the method makes no accommodation for the costs associated with risk itself, but methods 2 and 3 (and others) are suggested by it.

4. Direct application?

   Sometimes. A more direct approach would be to deal with either the payment pattern or the distribution of loss amounts first, and then consider the other, but often enough the number of events (i,t) is small enough that this method seems adequately direct.

5. Reasonable calculation?

   Usually. The risk manager seldom needs to identify so many events (i,t) that computation will require more than a single page of ledger paper.

III. TWO CHALLENGES

We have suggested several standards for determining the core of the science of our profession. If this approach--identifying objective criteria by which to judge actuarial methods--is valid, the analysis completed so far leaves us with two challenges.

1. Clean up the table shown in Exhibit 1. There are at least three areas of further work:

   a. Correct the entries in the body of the table. For example, is it true that credibility rules based on Bayes' rules seldom lead to simple calculations?

   b. Correct the column headings, especially those that assess what is teachable. Is there more? Or do these two qualities miss the mark? We need to review actuarial work the way ASC Ehrenberg (1981) has reviewed the preparation of tabular data.

c. Add to the topics. We need to be sure that all actuarial concepts are given a fair hearing.

2. In those cases where a method is good science but hard to teach, we need to develop simpler, more direct methods that retain the basic advantages of the methods.

   For example, credibility rules based on Bayes' rule haven't replaced intuition in most risk management applications. They won't until simpler and more direct calculations replace the current formulas. This can be achieved by introducing either 1) additional assumptions for special cases (i.e. the variance of workers' compensation claims is ten times the square of the mean), or 2) alternative calculations (i.e. determining the credibility of each cost center's claims from Just exposure and a list of the five largest claims in each cost center).

As these two challenges are met, we can respond to the greater challenge to rise to our most constructive role as scientists who develop better methods for ourselves and others to use.

REFERENCES

A.S.C. Ehrenberg (1981), "The Problem of Numeracy," The American Statistician (American Statistical Association), May, 1981.

Philip Kitcher (1982), Abusing Science (MIT Press).

HOW GOOD IS CURRENT ACTUARIAL SCIENCE (TO THE RISK MANAGER)?

Actuarial Method	Unified?	Assumptions Testable?	Fecund?	Direct Application?	Reasonab Calculati
1. The "actuarial equation" $\sum_{i,t} p_{i,t} v_t a_{i,t}$	Yes	Yes	Yes	Usually	Usually
2. Exponential utility $\frac{1}{r} \ln \sum_{i,t} p_{i,t} e^{r v_t a_{i,t}}$	Yes, more than #1	Yes	Yes	Less so than #1	Usually, l less than
3. Utility in general $\sum_{i,t} p_{i,t} u(a_{i,t})$	Yes, more than #2	Yes	Yes	No	Usually, same as #
4. Ad hoc methods of estimating loss development	No	No	Somewhat	Yes	Yes
5. Least-squares methods of estimating loss development	Yes	Yes	Yes	Yes	Only if a computer available
6. Ad hoc credibility rules	No	Yes, but assumptions usually incorrect	No	Yes	Yes
7. Credibility rules based on Bayes' rule	Yes	Yes	Yes	Sometimes	Seldom
8. Pure Bayesian approach to credibility	Yes	Yes	Yes	No (except in cases when #7 is equivalent.)	No
9. Monte Carlo simulation	Yes	Yes	Yes	Usually	Only if a computer available
10. Computation of convolutions	Somewhat	Yes	Somewhat	No	Seldom