



SOCIETY OF ACTUARIES

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a science in its babyhood. If civilization continues to advance, in the next two thousand years the overwhelming novelty in human thought will be the dominance of mathematical understanding."

The need for a greater public comprehension of the "dominance of mathematical understanding" is increasing at a rapid pace. The need is dictated by the increasing use of mathematical models with the aid of computers in an increasing number of fields of human activity. Social, economic, business, political, and ecological analyses are typical of recent applications of mathematical models, in particular stochastic models. The purpose of these models is to enhance understanding of the present relationships of relevant variables by forecasting their future relationships using computer iterations. This may permit better understanding and control of the modeled configuration.

This purpose coincides with that of actuaries in their use of mathematical models. Actuarial models, such as that implicit in a pension fund valuation, are submodels of a stochastic model of the world society and economy in its entirety. Examination of the similarities between the pension fund submodel and this larger model suggests many ways in which pension techniques can be helpful to the study of the more cosmic questions. An understanding of the pension fund actuarial model can contribute to greater public understanding of model design in general and design of a social system model in particular.

The "system dynamics" studies for world-wide, city, and corporate social systems, such as those made by Professor Jay W. Forrester and his associates at M.I.T., are good examples of the use of mathematical models. Their work appears to be bringing about a fundamental change in the way in which we must view the world. Their studies apply to all systems that change through time. Their techniques are a composite of mathematical models and other patterns of thought expressed in terms of symbols. In this way they seek to clarify and improve the mental models on which our actions are now based. The new insights gained from these studies need to be integrated into our thinking. A part of this thinking is the symbolic world of cost accounting (such as dollars, capital

expenditures, gain and loss), of economics (gross national products, health welfare programs, and other economic indices) and of actuarial science. These disciplines can better serve the institutions desired by society in the light of the new discoveries of Professor Forrester and colleagues.

Their work requires an understanding and acceptance of their findings by those who seek to apply them just as actuarial work requires an acceptance of the actuary's method by those who use his work such as pension clients. For a pension fund model this method involves the restatement in symbolic language of all aspects of the fund over time such as the magnitude of liabilities (both funded and unfunded), assets, income, and expenditures in dollars, and concepts of actuarial soundness. These must be understood by all concerned with the pension fund's operations so that they can know what actions must be taken in order that an actuarially sound plan may be maintained. The methodologies for system dynamics studies and for pension fund projections both seek to analyze the composite problem with its relevant important and understandable parts so that the relationship of each part to the whole may be in the proper proportion with the resulting good of a harmonious composition.

It is clear that computer models can do no more than spell out the implications of their own assumptions. The mind must continuously monitor the design of models in the light of developing future experience relative to that forecast. Those future events which are not dictated by fixed mathematical relationships can be changed by the actions of man himself and the assumptions underlying the model should reflect this. Human learning capacities, intentions, emotional reactions, mental patterns, and values, which determine assumptions in the first place, can also bring about their subsequent change.

The more nearly the computer input assumptions can be expressed as a fixed mathematical relationship verified by experience the more accurate the predictive value of the assumptions. Conversely, the greater the possibility that emerging experience can be changed by human action the greater is the probability that future experience will necessitate a change in those assumptions. This last group of assumptions can be classified as philosophic and subject to the limita-

tions of human knowledge and thinking. To the extent that this group of assumptions affects the overall validity of the results the model can be classified as philosophic, or as scientific, or as intermediate between them.

Psychologists and writers on the subject of forecasts, including pension fund projections, have emphasized two attributes of the mind which need to be taken into consideration if bias and error are to be minimized in rational thinking. One attribute is the tendency of the mind to adhere to the single future possibility that appears most probable or affectively most desirable, rejecting the more difficult alternative of contemplating a large variety of future possibilities. Dr. Samuel Johnson expressed this view as follows: "The future not yet being experienced is pliant and ductile in our thinking and will be imperceptibly molded by what we wish it to be rather than what in reality it may become. Also, the past once it has been safely removed, becomes ductile in our memory and the mind inevitably and imperceptibly plucks out of our total experience a pattern or ideal in order that our thinking may conform to our hope of what will become."

The second mental attribute is the tendency to confuse time perception, telescoping recent events while increasingly spacing out distant past events. The greater the distance from the present the greater is the tendency to space past events. In this way our conceptions of possible future events can be unduly influenced by the experiences of the recent past. These two characteristics of the mind underscore the need for careful evaluation of all input assumptions into computer models to minimize subjectivity in their selection.

Students of computer modeling agree that to maximize the validity of models, data affecting input assumptions must be obtained for as many diverse groups as possible and must reflect all available information from existing mental models, mathematical and otherwise. In order to select assumptions with which to construct actuarial models for pension projection reports actuaries face the same task—to obtain all relevant information, both general, e.g. demography, economics, and specific e.g., employment conditions including management and labor viewpoints, and other significant information from as many sources as possible.

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Through their reports they consequently promote a greater understanding of the value, and inherent limitations, of projections based on these assumptions and thereby help to bring about a greater understanding of more complex social and economic structures. In this way the public's interest, and the interests of the institutions served by actuarial science, are strengthened by improved understanding of how best to determine future actions that can be affected by changing future conditions.

Examples of such assumptions for a pension projection study would be: changes (1) in the rates of retirement, particularly those at the early retirement ages which can vary widely from year to year for many reasons; (2) in anticipated long-range investment earnings and asset values; (3) in salary, the scale assumption and its component parts; (4) in demographic and economic conditions; and (5) in the benefit schedules and their relationships, particularly to the new social security automatic provisions. The choice of the proper funding method, while not an assumption, also affects the determination of the optimum course of action. Similar assumptions for a system dynamics social study include changes in social values and life styles as ecological effects increasingly dictate the manner of living.

Applying Professor Whitehead's generalized views to the subject matter of this article, we conclude that the design of an actuarial model for a pension fund projection involves the weighing together of the fact, the theory, the alternative, the goal (ideal), and a comparison of the possibilities with the actualities. The results are insight and foresight for guidance in achieving the purpose for which the model is constructed. For the pension actuary that purpose is to maintain an actuarially sound pension fund under changing future conditions in a rational and just manner.

Since actuarial science is grounded in traditional ways of thought emphasized by Plato and validated by experience, it can make increasingly valuable contributions to society by helping to elucidate the manner in which the interweaving of mathematical relationships in a harmonious composition of things can contribute to the attainment of desired goals. □

Deaths

James A. Campbell
Jesse Feld
Bernard Jouvin
Louis R. Menagh
Jacques M. Winters

Book Review

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fourths of all biomedical research in the United States. War-related cutbacks in funds are blamed by him for seriously depleting the training of health research MDs and PhDs.

Among the subjects that he covers are the effect on mental development of malnutrition during the first six years of life, the history of American medical education, the harmful side-effects of improperly tested drugs, and the Rat Extermination Bill of 1967.

He gives a very interesting history of drug addiction in the United States, starting with the opium used by Chinese coolies in the 1840's. He sees the problem reaching major dimensions with the addiction after the Civil War of soldiers who were medically administered opium and morphine. This was followed by the opium-based "tonics" that were sold as pain killers to ex-soldiers later in the nineteenth century.

His discussion of overpopulation includes mention of the periods of Justinian (6th century), the Black Death (14th century), and the Thirty Years War (17th century) when the western world experienced "minus zero population growth." Today, he asserts, "overpopulation is, essentially, a poverty disease."

Chase's industrial fears are expressed thus: "Biologically, the ever expanding American technology represents a far greater threat to humanity and to the population of this country itself than does the continually declining American birth rate." His quarrel with the insurance industry is somewhat puzzling, particularly in light of the dominance of large mutual companies: "Private insurance companies exist to make profits for their stockholders. They have never had in the past, nor should they ever be expected to develop in the future, the professional skills that would enable them to contribute a thing toward the . . . lowering of health care costs, the introduction of innovations in the delivery of health care, and the maintaining of the quality of health care." Their business is not health care but insurance;

INVESTMENT PERFORMANCE

Donald Harrington made available a written presentation on "Measuring Investment Performance" at the teaching session on that subject at the St. Paul meeting. An expanded version is available by writing: Mr. Donald P. Harrington, F.S.A., Assistant Actuary, American Telephone & Telegraph Company, 195 Broadway, New York, N. Y. 10007. □

Pensions

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performance as well as comment on those matters which are peculiarly of interest and importance to persons particularly interested in public systems. This places a heavy burden on so small a book and this reviewer wonders whether the average reader will fully appreciate the significance of some of the carefully phrased sentences which imply more than is stated directly.

While the book gives a good picture of what the actuary does, it fails to make a straightforward statement of the importance of a professional actuarial analysis of costs and funding to protect the interests of those who pay for the system and those who benefit from it.

In summary, the book consistently takes a calm, dispassionate, academic view of this category of pension plans that exist in a pragmatic, political, and sometimes volatile environment.

Considering the expected readership, the author does a particularly fine job of discussing the actuarial aspects and the investment aspects.

Note: A more detailed review will appear in the Transactions. □

their expertise is not biology and medicine but finance and investments."

He concludes by suggesting the following tentative goals for an ideal health care delivery system: (1) Maximum protection, via medical and social techniques, of prevention of avoidable diseases and accidents; (2) early detection; (3) sufficient acute medical and surgical care; and (4) sufficient postacute, convalescent, rehabilitative, and terminal care.

A curious blend of polemic and history, recriminations and statistics, this book confuses as it teaches. Allan Chase's anger and frustration may cause the reader to question the credibility of some of the comments and recommendations that are obviously most important to the author. □