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ACTUARIAL EDUCATION

by James J. Murphy

Accompanying this issue is a letter from President Lantzenheiser introducing an attached statement, *Strategic Premise for Actuarial Education*. Developed by Michael J. Cowell, 1981-82 General Chairman of the E & E Committee, its concepts, although not previously assembled into one document, have been guiding the Society's education efforts for decades. It will now provide useful background for consistent and organized changes in our education system.

While it was being written, several Education Task Forces have been preparing recommendations for changes in our syllabus. Articles by two of these Task Forces that have completed their work are printed here, viz.:

Operations Research and Applied Statistics

Mathematical Aspects of Demography

As other Task Forces complete their assignments, we will present similar reports in *The Actuary*. Also, as new Task Forces are established, we will announce them and will call for ideas and volunteers. Keep your eyes open for more news from E & E!

Operations Research and Applied Statistics, (James A. Tilley, Chmn.)

Formed in September 1981, with members drawn from both the academic and business communities, and with representation from the Canadian Institute of Actuaries and the Casualty Actuarial Society, this Task Force began by establishing criteria to guide us to decisions on syllabus and course of reading. Our starting premise was that the scope of actuarial work will continue to broaden to embrace all aspects of the financial products and services business; hence, actuaries should become familiar with

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TWO CENTURIES AGO, THE NORTHAMPTON TABLE

To mark this year's bicentennial of Richard Price's Northampton Table—the earliest mortality table to be constructed especially for life insurance premiums—we show here the contrast of its life expectancies with those of population tables of, respectively, one and two centuries later.

Complete Expectations of Life

Age	Northampton Table (Data of 1735-1780)	English Life Table No. 4 (Data of 1871-1880)	Calendar Year 1980 U.S. Life Tables *
0	25 yrs.**	43 yrs.	74 yrs.
20	35	41	55
35	26	30	41
50	18	20	28
65	11	11	16
80	5	5	8

*from *Actuarial Study No. 87*, Joseph F. Faber, Social Security Administration, Sept. 1982.
 ** q_0 in the Northampton Table was .258!

Since the two later of the above tables are sex-distinct, these figures show for them the arithmetic means of the e_x values for males and females.

Notes on the Northampton Table

Actuary Price, well experienced by having studied mortality in other English towns and aware that he was aiming to generalize from a tiny base (a single church parish), evidently felt free to take major liberties with his data. The many adjustments he made were not in the values of q_x but in the column of deaths. For example, he showed exactly 75 deaths at every age from 21 to 39, 82 deaths each year from age 51 to 61, and 80 deaths from 64 to 75, in a table whose radix was 11,650 at age 0.

The improvement in longevity between the Northampton Table and English Life Table No. 4 is attributable in part to acknowledged overstatement of mortality in the former, and in part to progress in sanitation and medicine. Vaccination was introduced into England by physician Edward Jenner in 1796.

The Northampton Table, though by no means the earliest—Halley's Breslau table dates from 1693 and Kerrsboom's in Holland from 1738—is bound up with the history of the Equitable Life Assurance Society (of London). Griffith Davies, in his *Treatise on Annuities* (1825) quotes Price's nephew, William Morgan, thus:

“(T)he Society had computed all their premiums from the (early 18th century) London Table of Observations (but, after seeing their experience from 1768 to 1780) they determined to compute the premiums in future from a table which should give the probability of life *higher* (emphasis in original) than that which they had hitherto used; and for this purpose they adopted one which had been just formed by Dr. Price, from very accurate observations made in the town of Northampton.”

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Actuarial Education

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quantitative methods arising from other disciplines to solve new problems and to add new perspectives to old problems. Our educational goal, though, should be to train *generalists*, not *specialists*.

The syllabus should present a wide range of mathematical topics which have, or potentially have, useful applications to practical actuarial problems, or which help actuaries to communicate effectively with those in allied professions. It should develop those topics in a way that emphasizes fundamental principles and concepts, and that reveals the limitations of techniques and the necessity for scrutinizing results for reasonableness and for consistency with the underlying assumptions.

The result is that the following topics will be on the new Part 3 syllabus:

Operations Research: Linear and dynamic programming, decision analysis, queuing theory, project scheduling, simulation.

Applied Statistics: Regression analysis, analysis of variance, time series analysis.

The course of reading will include parts of the text, *Operations Research* (Holden-Day) by Hillier and Lieberman, chapter 4 of the Society's text, *A Study Manual For Operations Research*, Eugene A. Narragon (Ed.), and parts of *Intermediate Business Statistics* (Holt, Rinehart and Winston) by R. Miller and D. Wichern.

These syllabus changes, as well as some in the readings for numerical methods, will take effect for the May 1983 examination, its length becoming four hours.

A study note on simulation is being written, and one on actuarial applications of applied statistics is planned; these will be effective no earlier than November 1983. Also, changes in the 1984 syllabus are being developed by the Task Force on Numerical Methods and Graduation.

Anyone wishing a copy of this Task Force's Report or more particulars on the 1983 Part 3 syllabus, ask Linden N. Cole at the Society office.

Mathematical Aspects of Demography, (Judith A. Faucett, Chmn.)

Demography, a topic long covered on Part 5, was reduced in 1979 to *Mathematical Aspects of Demography* with the intent that non-mathematical aspects would be placed on a Fellowship exam. Unfortunately this hasn't yet been done, so students are being required to absorb mortality and demographic statistics without guidance on how or when to use them.

Demography is a valuable tool for actuaries; the need to forecast populations has become evident in the health, pension and other financial security fields, and ties in with increasing use of life company corporate models. This Task Force recommended that Demography be split into two sub-topics, viz.:

Survival Models and Data Analysis

- Mathematics of Mortality and Morbidity Measures
- Survival Distributions
- Fundamentals of Life Table Construction
- Studies Based on Incomplete Data
- Comparisons of Mortality Data

Population Forecasting

- Methodology & Sources of Mortality and Morbidity Measures
- Use of Government Statistics
- Mortality and Morbidity Characteristics and Trends
- Forecasting Methods

Survival Models and Data Analysis would replace *Mathematical Aspects of Demography* on Part 5B. Population Forecasting, the only completely new subject matter, would more appropriately go on the Fellowship syllabus.

As text, the Task Force chose *Survival Models and Data Analysis* by Regina C. Elandt-Johnson and Norman L. Johnson, the latter an F.I.A. This book, using actuarial notation, describes methods for analyzing data and constructing interpretive models, with emphasis on general principles; examples are interspersed, and each chapter offers a lengthy set of problems. One drawback is absence of solutions, but the possibility of preparing sample solutions is being explored;

also, there are too many printing errors, requiring us to distribute a formidable errata list.

These Part 5B changes will be effective in 1983. A new Task Force will tackle the Population Forecasting sub-topic, likely to take longer to introduce because texts are lacking. Anybody interested in being part of that Task Force or in writing study notes, please let Education Chairman Sam Gutterman know, at his Yearbook address. □

Restructuring

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with flexibility as a major objective. Also, the degree of specialization, which had been increased in the 1976 restructuring, was further increased. In the new Parts 9 and 10, there are now three specialties, and each candidate chooses a major specialty and a minor specialty. The three specialties are Individual Life Insurance and Annuities; Group Insurance and Individual Health Insurance; and Pensions.

The point about increasing specialization is worth some comment. If everyone has to learn about everything, the Education and Examination Committee is faced with some difficult decisions as the world grows more complex. There is, after all, an upper limit to the material we can ask our students to learn. Once that limit is reached, new material can be added only by deleting old material. The ultimate effect is that every subject is gradually cut down, and nothing can be treated in depth. By abandoning the objective of making everyone learn everything about every subject, and requiring pension specialists to learn some things that insurance specialists do not have to learn, and vice versa, it becomes possible once again to treat important subjects in satisfactory depth. The new syllabus requires everyone to learn something about every subject, but not everything.

So far, at least, the new structure is proving to have the flexibility hoped for it. It should last for many years because of its ability to accommodate change. Also, the pension content is stronger, and potentially much stronger. The task remaining is to examine every subject area, to assure that the study material is current and of high quality. Perhaps that will be the major task in the 1980s. □