DISCUSSION OF PAPERS PRESENTED AT THE SPRING MEETINGS

FREQUENCY DISTRIBUTION OF MORTALITY COSTS

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SEE PAGE 1 OF THIS VOLUME

ROBERT L. WHITNEY:

The application of the concept of using a series of random numbers with a view of taking many random samples in order to estimate variables under study is a very powerful tool. Mr. Boermeester is to be thanked for giving a very interesting and practical application of the Monte Carlo method, as it is sometimes called.

At the Mutual of New York we have also used the IBM 650 to apply this concept. The problem, which I will state later, came up in our studies of premium billing and accounting applications on current electronic data processing machines.

In our studies of the IBM 650 with magnetic tape we have adopted the variable message length concept. That is, many items such as loan balance, dividend accumulations, multiple field underwriter information, etc., are carried in the message only when they are nonzero. Additional coding within the message is needed to show what types of additional items are being carried.

We have studied in detail the advantages and disadvantages of grouping messages within one block (record) of information on magnetic tape. The main advantage is that with an interrecord gap for every 3.5 policies instead of every policy the time to pass the entire master file through the 650 daily is materially reduced. The main disadvantage is the increased complexity of the program.

Our problem, then, which came up in this study was to find: (1) the average number of *complete* messages we could get within a fixed block length, and (2) the average waste within the fixed block length that was not used by *complete* messages.

Statistics were available which readily yielded the probability distribution of message lengths. Using this probability distribution a program was set up for the IBM 650 for the above problem. First a random number was generated, and then, based on the random number, a

message length was chosen. The design was that if the probability was .15 that a message length was 13 words, then on 15% of our·trials the message length would come out as 13 words. Given the message length of successive policies on successive trials, it was a simple matter to keep the tallies needed to give answers to our problem.

The method used to generate random numbers was that described by Mr. Jack Moshman in an article entitled "The Generation of Pseudo-Random Numbers on a Decimal Calculator" appearing in Vol. 1 of the *Journal of the Association for Computing Machinery*. This method has the advantage that the resulting numbers have been examined according to five criteria of randomness and satisfy all five. The numbers resulting from Mr. Boermeester's method probably would satisfy the five criteria also, but it appears that they have not been tested for any criteria of randomness.

Our 650 program made about 500 trials per minute. It was repeated for varying block lengths and for slight changes in the distribution of message lengths.

The Monte Carlo method is just one of the procedures that mathematicians have worked out in recent years which make it possible to solve a wide variety of important problems much faster, more easily, and more accurately than ever before. Actuaries should be interested in this field of Operations Research, for the insurance industry undoubtedly has areas where Operations Research make it possible to present management with better information for better decision making. Market Research and Analysis and Control of Costs are two fields, for example, where Operations Research can help solve problems.